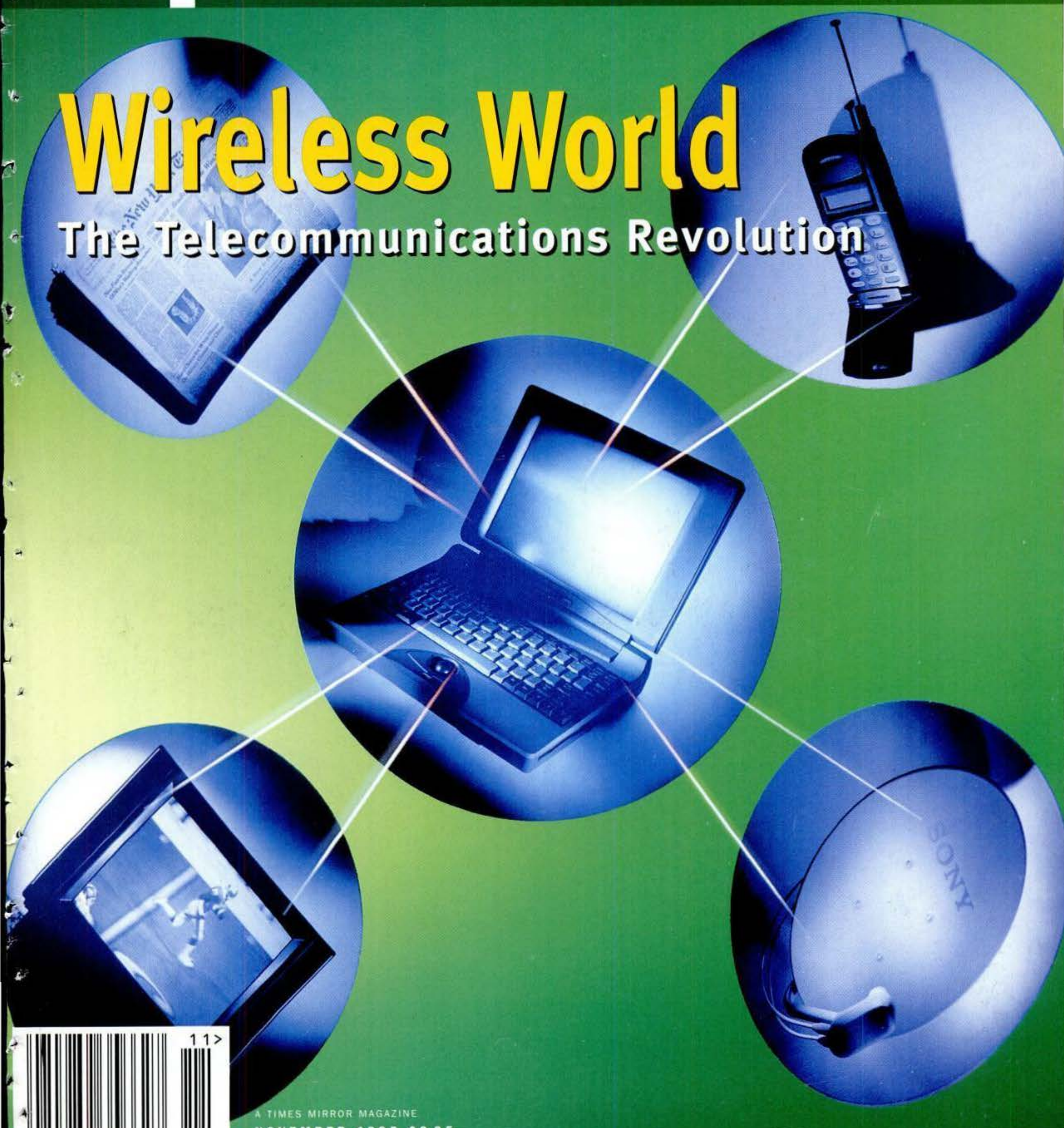
Essential Guide to TV | Fat-Fighting Hormone | Honda's Green Civic | The Flying Wing

Popular Science

Wireless World

The Telecommunications Revolution



A TIMES MIRROR MAGAZINE
NOVEMBER 1995 $2.95
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OUR DESIGNS BUT OUR *PHILOSO*

At FORD MOTOR COMPANY, we've always worked with one basic premise: that the design of a car or truck must go beyond how it looks. It's a simple but SOUND PHILOSOPHY that has taken many shapes over the years, from the Model T, to the Continental, Taurus, Explorer and Mustang. Resulting in cars and trucks that are CELEBRATED FOR THEIR DESIGN, and earning Ford Motor Company the distinction of having five of the ten best selling vehicles in America today. Consistent with this philosophy, today we are

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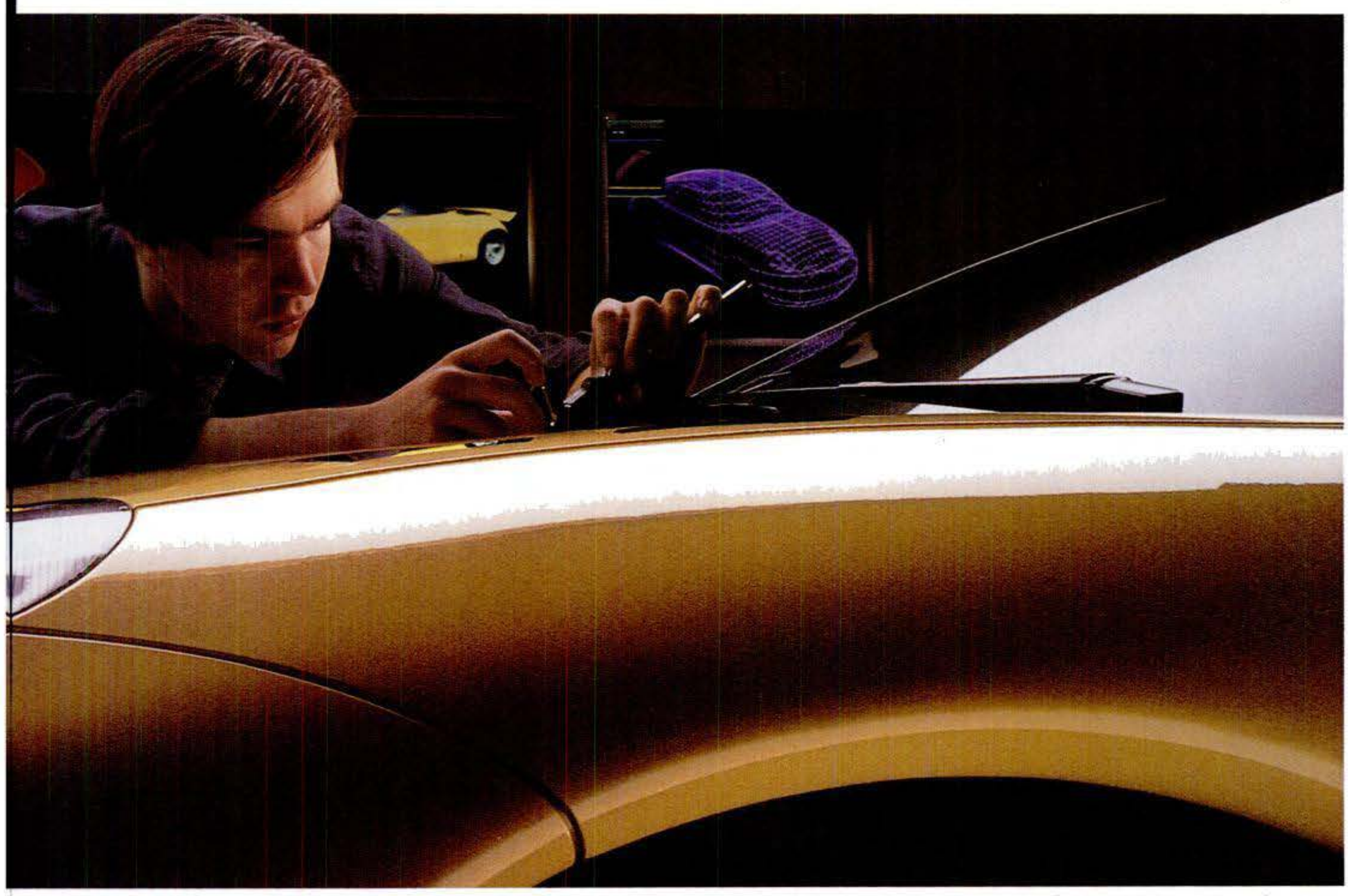

Ford Designers: Soo Kang, Robert Bauer.

applying the latest technology and the MOST DETAILED craftsmanship to EVERY ASPECT of EVERY AUTOMOBILE we create. By working with the automotive industry's most powerful supercomputer, our worldwide design team are indeed becoming the CRAFTSMEN OF THE FUTURE.

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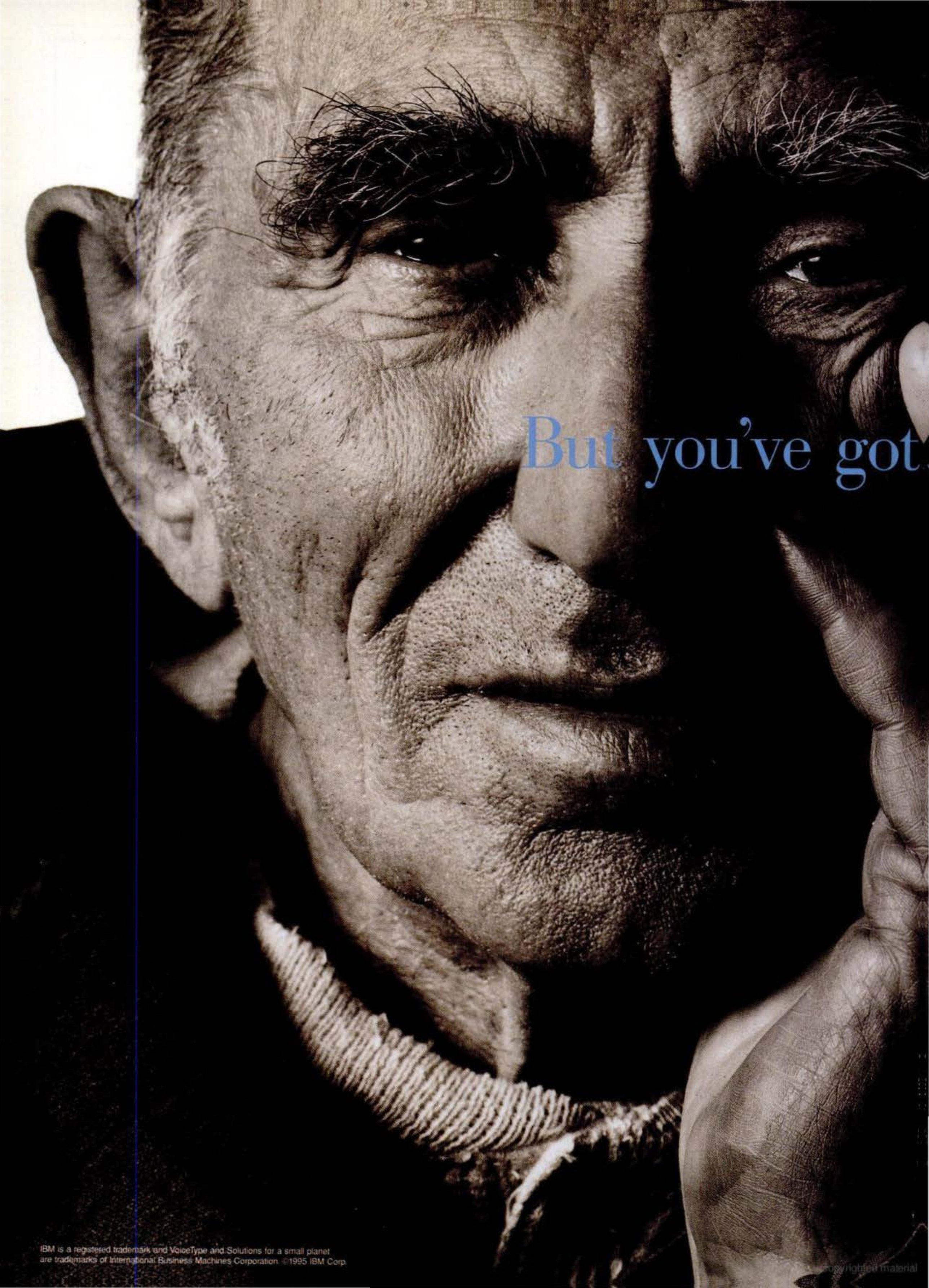

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Gavin just finished his epic poem, "The Iceberg, the Walrus and the Fisherman's Elbow."

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This One

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"My husband is at sea on a submarine. A lot of the crew wear Indiglo watches. While submerged, they have these lights-out drills that can last for hours... When someone bonks their head, it's never the guys wearing your watch..."

– Molly D. Culligan, Charleston, S.C.

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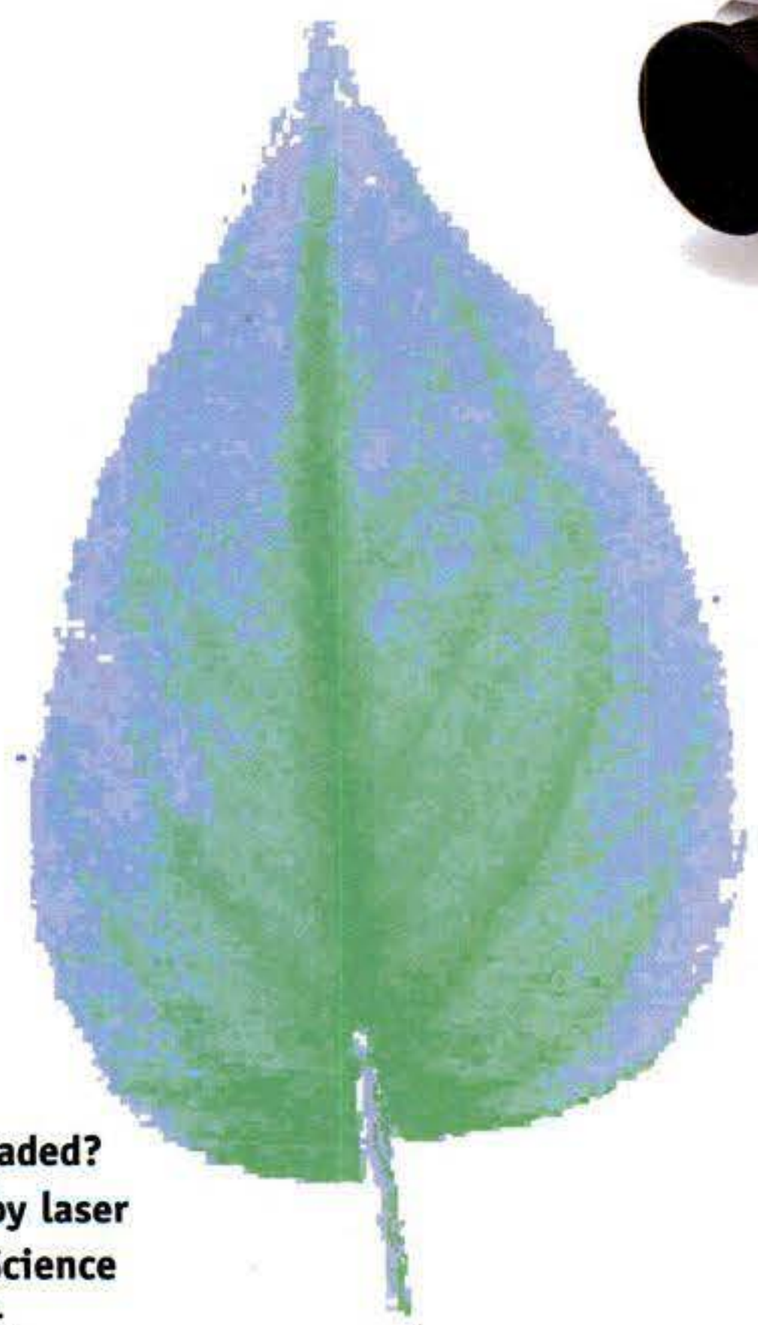
THE WHAT'S NEW MAGAZINE

11 PS 95

A TIMES MIRROR MAGAZINE

47
Digital videocassette camcorder is hot in Electronics Newsfront.

67
High-technology hits and misses for TV watchers.



51
Fresh or faded? Analysis by laser pulse in Science Newsfront.

DEPARTMENTS

7 **Letters**
12 **What's New**
Newsfronts
27 Home Technology
31 Automotive
37 Computers and Software
40 Beyond Here
47 Electronics
51 Science and Technology
80 **PS Feedback**
81 **FYI**
104 **Looking Back**

COVER STORY

56 The Wireless World
Offering untethered, unplugged travel, the information skyway is coming soon to a wireless device near you.

Cover art by Geoff Spear

Founded in 1872 Volume 247 Number 5

FEATURES

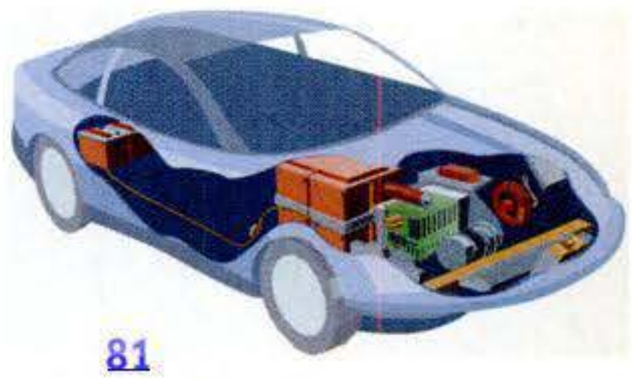
64 Lean, Mean, and Green Honda's all-new low-cost Civic offers quantum-leap improvements in fuel efficiency, emissions, and safety.

67 Essential Technology Guide to TV Go on, be a couch potato. Just be sure you do it in high-tech style. Our tech tour tells you how.

72 The Wing Flies Again An exquisitely restored 1940s Northrop flying wing is back in the air. It still looks like the shape of tomorrow.

78 Honey, I Shrunk the Mice! A newly discovered hormone cuts the weight of obese mice. It may hold hope for the nation's legion of frantic dieters.

12
What's New: Multipurpose saw is king of convenience.



81
FYI: lowdown on how an electric car works.

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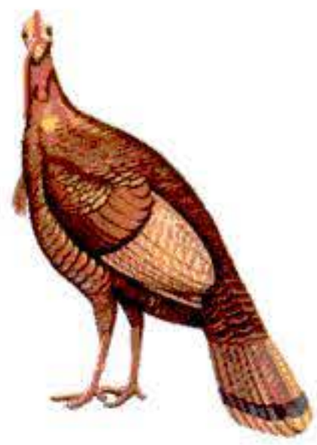
With any luck, there'll be leftover turkey.



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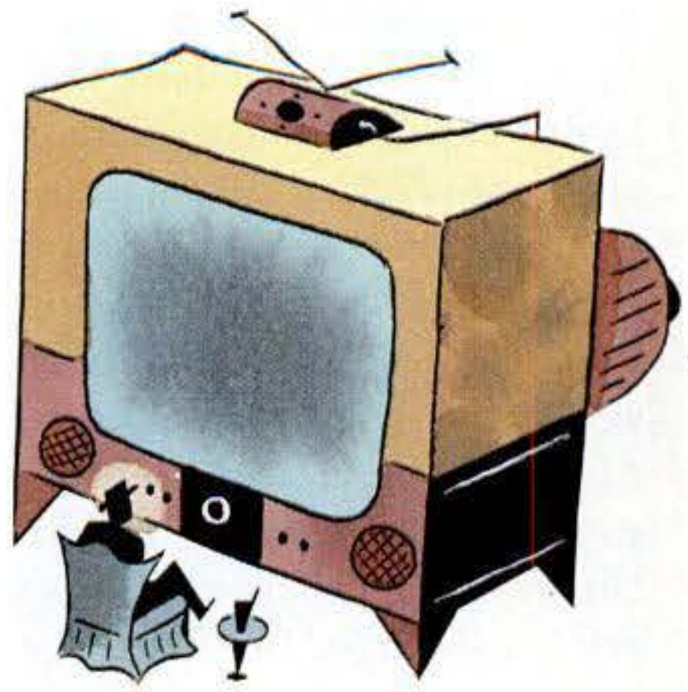
MICHAEL KLEIN

From the Editor-in-Chief

WE HAVE SOMETHING NEW for you in this issue: POPULAR SCIENCE'S Essential Technology Guide. This month, the topic is television. On a regular basis, we'll be presenting guides that offer you a practical, useful look at how technology affects everyday pursuits—from recreational activities, to health and fitness, to personal finance. The point is, technology is a major influence in the products and services that we buy and consume in every aspect of our lives. Please let us know what you think and which topics you'd like us to cover in the future.—*Fred Abatemarco,* **popscied@aol.com.**



Nuclear-Energy Notes

NUCLEAR POWER has always been clean ["The Nuclear Legacy," Aug.]. Almost all of the pollution reductions in the control of carbon dioxide emissions proposed by the Clinton administration come from using nuclear power. Certainly we must move forward with plans for the disposal of spent nuclear fuel. But that should have no impact on operating power plants, especially if we construct an interim storage facility. With more than 100 plants operating in the United States and about 400 worldwide, the true legacy of nuclear power is a clean and efficient energy source.

Theodore M. Bessman
Oak Ridge National Laboratory
Oak Ridge, Tenn.

YOU'RE WRONG to claim that no one has found a safe, permanent way to dispose of nuclear waste. Every country with a nuclear-energy program has agreed that nuclear-fuel disposal can be done safely using geological storage, and all have development programs underway. Major scientific groups, including the National Academy of Science, have endorsed this method. Two other inaccuracies: The production of electricity from nuclear plants is cost competitive with coal-fired generation and cheaper than that of oil or natural gas. Second, the federal government collects one-tenth of one cent per kilowatt-hour of electricity to dispose of used fuel from nuclear plants—not one cent, as you report.

Philip Bayne
President, Nuclear Energy Institute
Washington, D.C.

Nuclear power looks competitive with fossil fuels if you look only at the cost of electricity production. What makes nuclear power expensive is the high cost of meeting safety standards. Although many nations agree that geologic disposal is the way to go, none has completed the testing necessary to prove that the idea works.—Dawn Stover

Nothing to Lose

YOU REPORT a cure of acrophobia—fear of heights—with virtual reality in Electronics Newsfront [Aug.]. But I don't think the technique will help with that many phobias, since there is no actual danger of being injured. I could fly a simulated airplane right at the ground without fear—but if my commercial flight did that, I would be more than unhappy.

Robert Palmer
Bobby159@aol.com

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Minivan Gripes

IN "THE ULTIMATE Household Appliance" [Aug.], you deem the Dodge Caravan's left-side sliding door "one-of-a-kind." What planet is your magazine published on? The Nissan Multi was first, in about 1986; both rear doors of the minivan were of the sliding type. The Nissan Axxess, which replaced the Multi, also had sliding rear doors. I drive a Nissan Axxess and have yet to see anything from the Big Three that can even stand in its shadow.

David J. Perry
Moose Jaw, Saskatchewan, Canada

The Axxess was discontinued by Nissan after the 1990 model year.

YOU LIKE the Chrysler Town & Country's looks, yet loathe the Ford Windstar's. I never thought anyone could like one and not the other—especially considering that if you covered up the grills on each vehicle, they'd look exactly the same. I also would have liked to see a comparison of safety features.

Brian Kennedy
prsc97b@prodigy.com

Obsolete Isn't Inferior

IN "THE LAST Voyage of the Hiddensee" [Aug.], you misguidedly disparage the antiquated Soviet mechanical computers. I worked on similar computers on the Air Force's F-111A fighter/bomber in the early 1980s. The beauty of mechanical, as opposed to digital, computers is that they are less likely to fail during the electromagnetic pulses created after a nuclear bomb detonation. Incidentally, you could also operate a compact disc player or make a cellular phone call on airplanes equipped with mechanical computers, because the high frequencies those devices generate would have no effect.

Craig Watanabe
Honolulu, Hawaii

Positive Role Model

WOW! I LOVED the last line of "Beyond Visual Range: Flying the F-22" [Aug.], where you learn the F-22 leader is female. What a refreshing change from the stereotypical male as military-aircraft pilot.

Melony Whetstone
Pilot/Flight Instructor
Daytona Beach, Fla.

Stinky No More

MY FAMILY can't thank you enough for printing Paul Krebaum's antidote for a skunk's malodorous revenge [Science Newsfront, Aug.]. Just days after receiving your magazine, our dog, Foxxy, got into a scrape with an angry skunk. As promised, the antidote worked instantly. It's a good thing; the neighborhood children had begun to call our dog "Stinky Puppy." I can't help but wonder: There's got to be a way to market the stuff in a sealed container.

Cuitla Huezo
Cuitlahuac@eworld.com

The Wrong Main Culprit

I DISAGREE with your warnings against "toxic" cleaning products in "50 Things You Can Do to Save Our Oceans" [June]. A majority of household cleaning products are formulated to be safely disposed of in wastewater treatment systems. Testing and compliance with regulations ensure the continued safety of cleaning products. Second, there are virtually no laundry detergents in the U.S. marketplace that contain phosphates. Phosphates are still an ingredient in automatic-dishwasher detergents. But that use contributes less than one percent of the phosphorus found in lakes and rivers; the principal source is runoff from fertilizers and construction.

Janet Donohue
The Soap and Detergent Association
New York, N.Y

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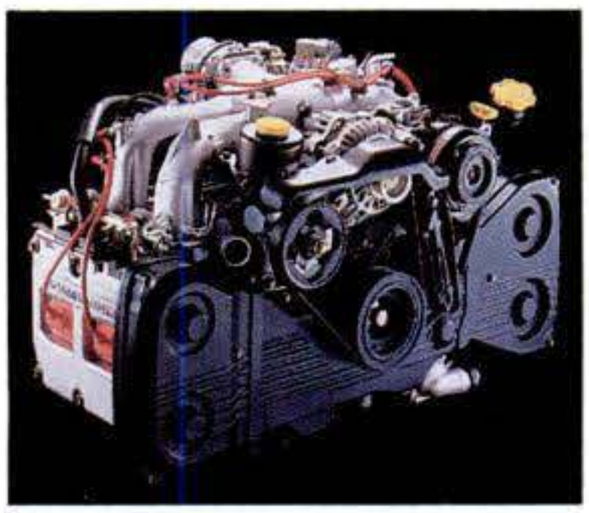
APPLES TO APPLES.

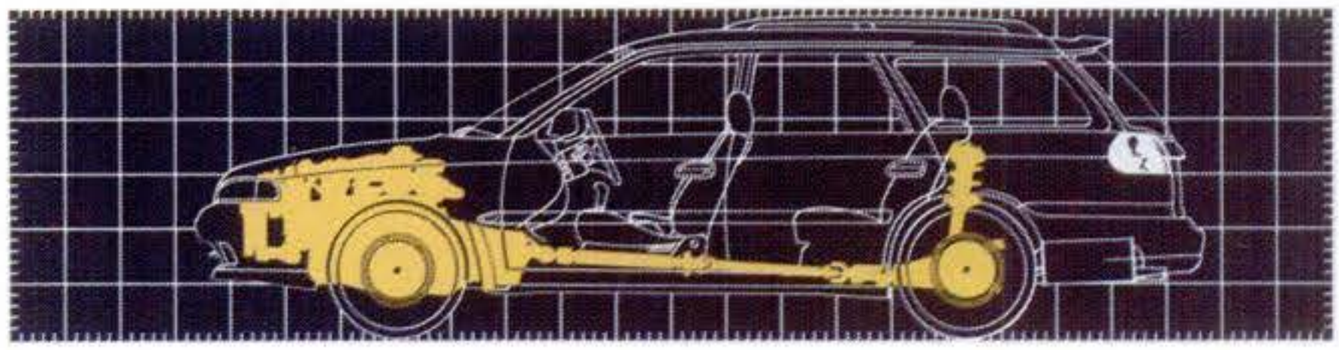
The *nerve of us. Pit the engineering* **Subaru Legacy 2.5 GT** *ingenuity of the legendary Porsche 911 Carrera 4**



against that of the new Subaru All-Wheel Drive Legacy® 2.5 GT? Preposterous! And yet — call us crazy — we see distinct similarities.

TWO BOXER ENGINES: HORIZONTALLY OPPOSED, YET SO MUCH ALIKE.

Ah, the boxer engine. A unique horizontally opposed configuration with a lower center of gravity that increases stability and reduces vibration for a smoother, more enjoyable ride. Naturally, Porsche's got one. Well — talk about similarities — so do we! *(Eerie, huh?) Ours is a 2.5-liter, 16-valve, DOHC beauty. And though our 155 horses may not be quite as numerous as theirs (270 hp), the 2.5 GT's low-end 155 lb-ft torque delivers a highly responsive, high-performance engine. So responsive, we use a modified version to propel Subaru to victory in road rallies worldwide.*



THE TRACTION CONNECTION: ALL-WHEEL DRIVE.

Sure, the Carrera 4 sticks to curves like bug splats on a windshield. Maybe that's because Porsche has seen fit to equip their top-of-the-line car with the superior traction and control of All-Wheel Drive — just like us! Subaru All-Wheel Drive continuously monitors road and weather conditions, automatically transferring power from the wheels that slip to the wheels that grip — actually helping you avoid accidents. Combine this with a horizontally opposed engine and optimally tuned suspension, and you have all the makings of the Subaru All-Wheel Driving System, a unique system that makes the Legacy 2.5 GT daringly fun to drive.

LEGACY 2.5 GT

THE TWO FACES OF BEAUTY.

We're the first to point out: When it comes to style, the Porsche 911 is one of the hottest cars going. But with aerodynamic ground effects bodywork, contoured halogen headlights, rear

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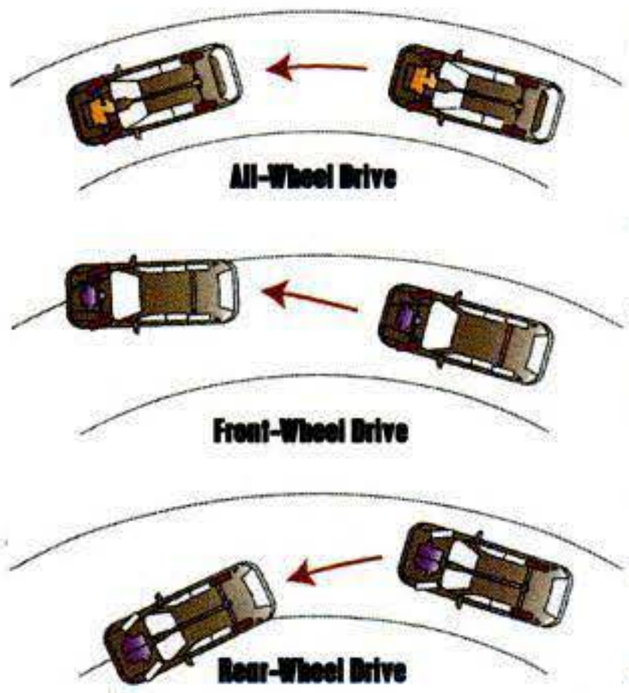
OR TOTALLY NUTS?

Porsche 911 Carrera 4

decklid spoiler and polished 5-spoke alloy wheels, the Legacy 2.5 GT is sure to spice up the daily commute, as well. Inside, too, it's engineered with both style and ergonomics in mind. With easy-to-read analog gauges, easy-to-reach controls, a deeply bolstered, 10-way adjustable driver's seat, with matching velour door trim inserts — even a retractable dual cupholder — the 2.5 GT driving environment is actually built around a driver, *not a formula. What's more, its superlative design is available in two sleek body styles: the sporty Legacy 2.5 GT Sedan and the roomy Legacy 2.5 GT Wagon. Body styles, we might add, that Porsche doesn't even make. (Oh well, so much for comparison.)*



911 Carrera 4 included. What's more, with an EPA fuel economy of 20/26 mpg, the Legacy 2.5 GT has a much less voracious appetite. And with typical Subaru low maintenance, it won't cost you much down the road, either.

So there you have it. But don't take our word — compare for yourself. See your local Subaru dealer for a test-drive, or call us at 1-800-WANT-AWD.

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Pictured is the Porsche 911 Carrera 4. †MSRP of Legacy 2.5 GT Sedan 4EAT with a 2.5-liter engine. Price does not include inland transportation, taxes, license and title fees. Dealer's actual price may vary. 1996 EPA estimate. Your mileage may vary.

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WHAT'S NEW

EDITED BY MARIETTE DiCHRISTINA AND SUZANNE KANTRA KIRSCHNER

The Red and the Black

LAND ROVER'S Range Rover 4.6HSE packs a 4.6-liter V8 under the hood. Developing 225 horsepower and 280 foot-pounds of torque, the engine propels the limited edition off-roader from 0 to 60 in 8.5 seconds. On-road handling gets sportier with 255/55HR18 low-profile Pirelli tires mounted on five-spoke alloy 18-inch wheels. For $62,000, you get a choice of two colors: Beluga Black or Rioja Red.

Automatic Antenna

FORGET THE UGLY old rabbit ears. Under direction from the National Association of Broadcasters, MegaWave Corp. of Boylston, Massachusetts, moves TV-antenna technology a step forward for the first time in 20 years. A microprocessor inside this prototype automatically adjusts for the best reception when you switch channels.

Toe Jam

GENESIS INLINE skates are the first to sport a built-in toe brake: Instead of scooting your heel forward, you drag your toe. The skates cost about $90 from Seneca Sports, Box 719, Milford MA 01757.

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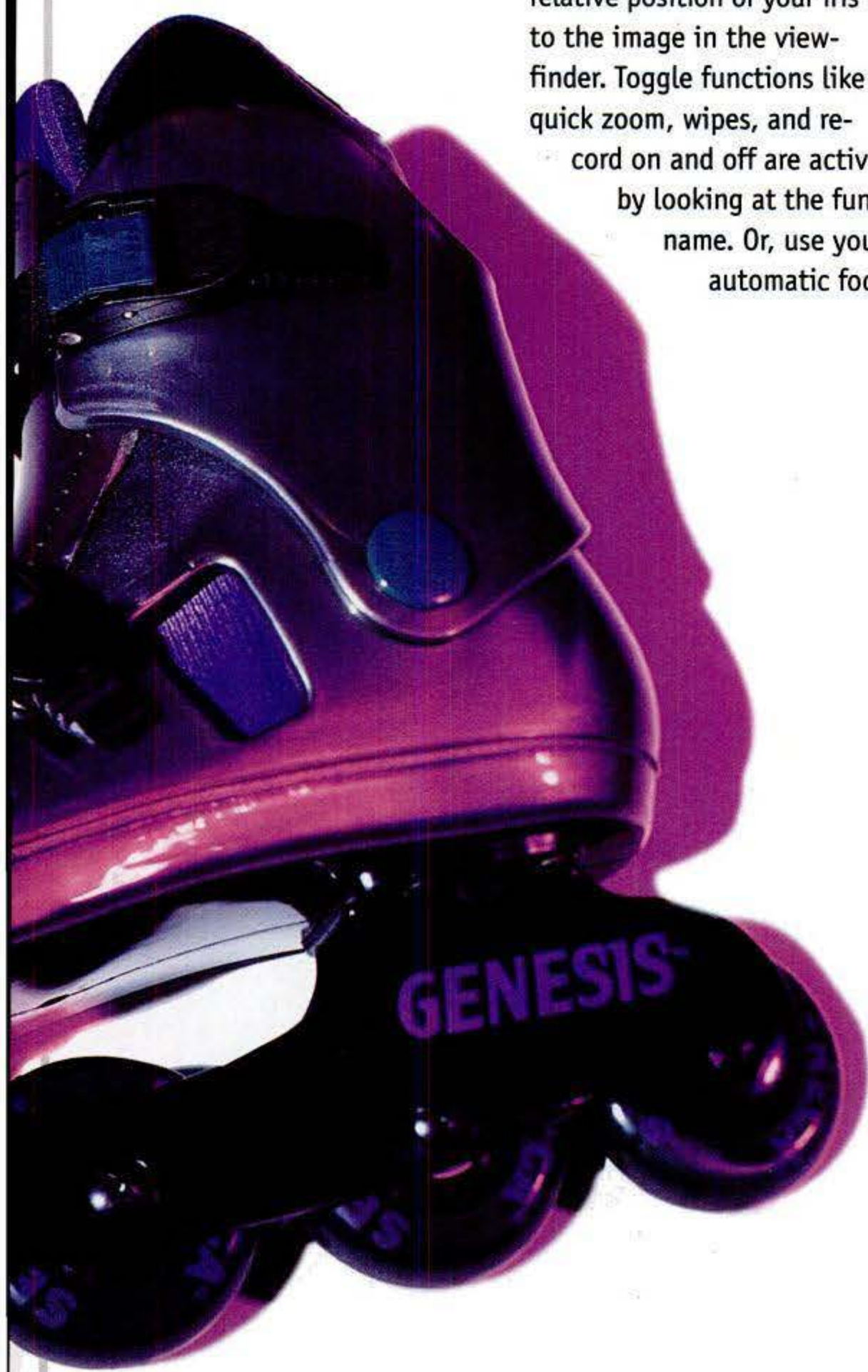
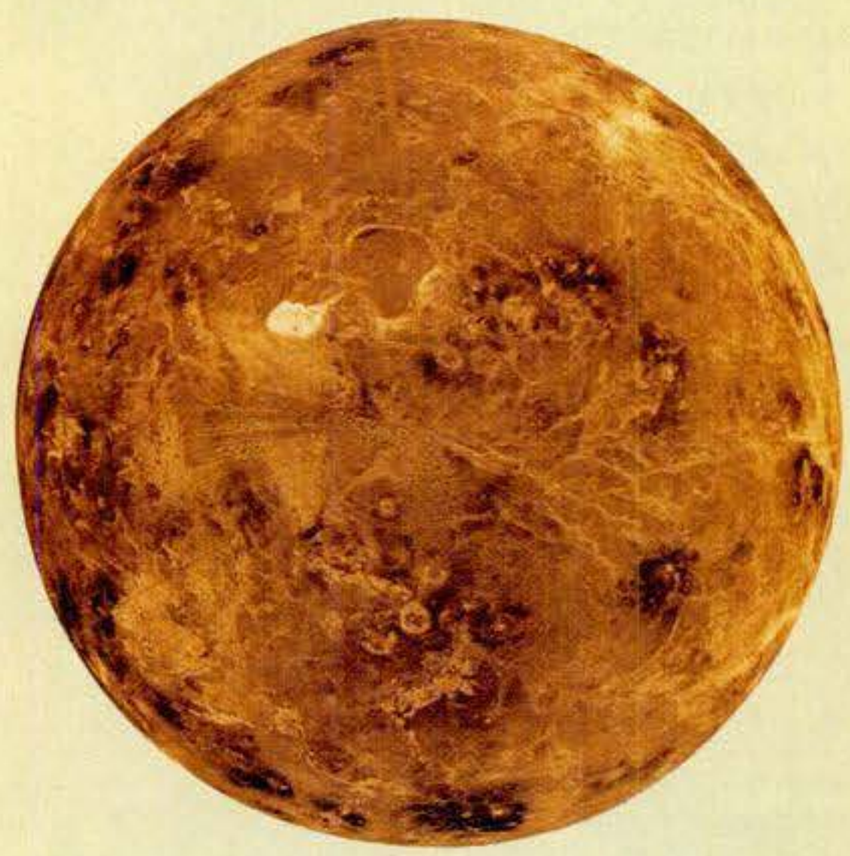
Eye Control

THE CANON ES5000 knows where you're looking. A beam of light monitors the relative position of your iris to the image in the viewfinder. Toggle functions like quick zoom, wipes, and record on and off are activated by looking at the function name. Or, use your eye to move the automatic focus box. Price: $2,200.



Global View of Venus

THIS PICTURE combines all of the radar images collected by the Magellan spacecraft during four years of mapping Venus. To create the picture, individual radar images were laid onto a grid of the planet's latitude and longitude. The simulated colors are based on pictures taken from Soviet spacecraft. The bright region near the center is the planet's highest mountain range.



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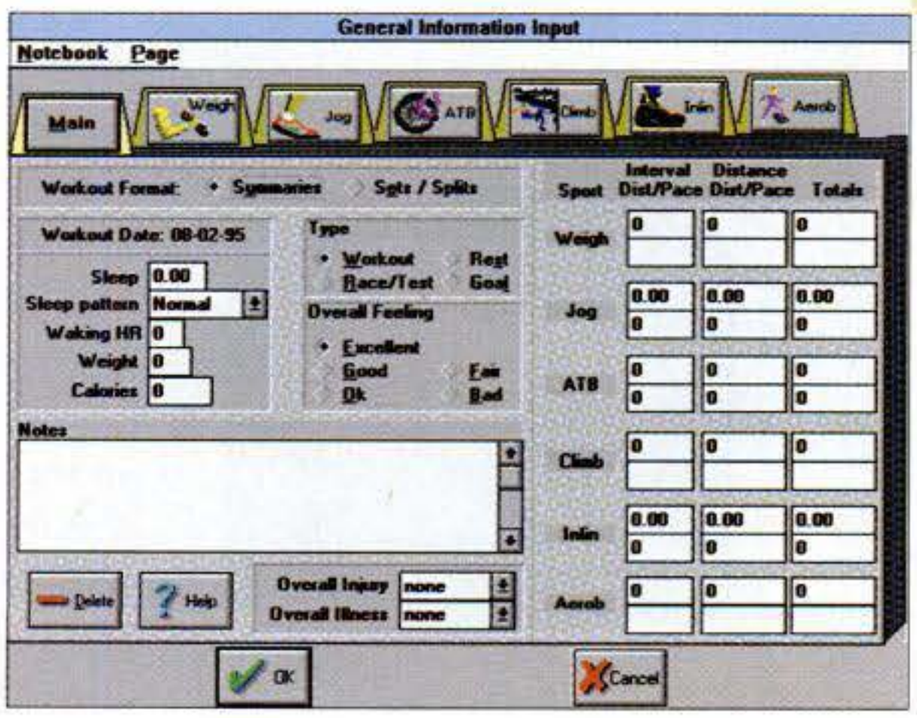

Personal Trainer

IF YOU'RE serious about getting in shape but don't want to pay a personal *human* trainer, UltraCoach for Windows provides a software alternative. Using data that you've keyed in, UltraCoach creates personalized workouts that take into account your caloric intake, outdoor temperatures, even how much sleep you've had the previous night. The price is $80. UltraCoach, 9635 Monte Vista Ave., Ste. 201, Montclair CA 91763.

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Racing with the Sun

POWERED BY a blazing sun, almost two dozen catamarans, hydroplanes, and styrofoam canoes raced along the shore of Lake Michigan in the 1995 Solar Splash, a solar/electric boat regatta involving 170 students from 15 U.S. and Japanese schools. Japan's Kanazawa Institute of Technology won the 30-kilometer endurance event with a 9-mph hydrofoil (pictured); part of the craft lifts above the water to reduce drag. The University of Arkansas entry, using a motor adapted from an industrial forklift, hit 25 mph to take the 300-meter sprint event.

Zip City

BLACK & DECKER'S multipurpose saw is the king of convenience: It's cordless and handles wood, drywall, PVC pipe—even tree limbs. With a variety of jig-saw and multipurpose blades, the tool cuts wood workpieces as thick as two inches. It runs on two 3.6-volt VersaPak rechargeable batteries; by purchasing a few extra batteries, users can keep the tool juiced at all times. Tool price: $40 (two batteries and recharger cost about $29).

Future Truck

FORD'S RESTYLED 1997 F150 pickup, due next January, has an all-new chassis designed to improve ride and handling. Engines include a standard 4.2-liter V6 and 4.6- and 5.4-liter V8s. Five-speed manual and four-speed automatic transmissions are available. Dual airbags are standard, with four-wheel antilock brakes optional. Prices are not yet set.

Jetsons' TV

SPACE-AGE styling distinguishes Goldstar's 13-inch Fashion TV. The $300 set's spring-loaded dial whizzes through channels while a curved row of consecutively blinking LED displays forward or backward selection.

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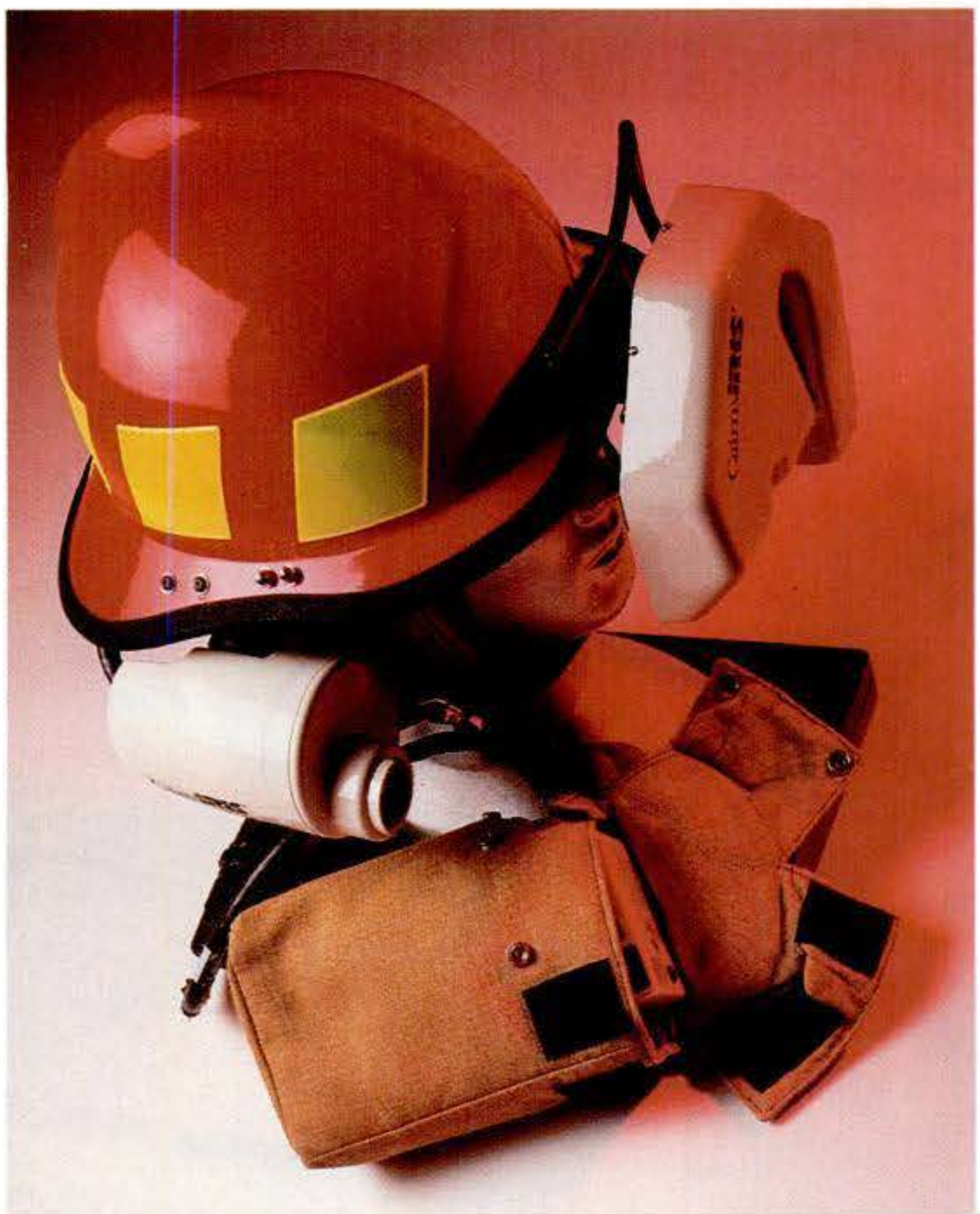
Seeing in Smoke

FIREFIGHTERS CAN "see" through dense smoke and darkness with the CairnsIris helmet-mounted thermal-imaging system. The $25,000 2.8-pound unit perceives temperature variations of as little as 0.5°F—revealing a motionless victim, an unstable floor, or a fire raging behind a wall. Cairns & Brother, Box 4076, Clifton NJ 07012.

Photo Printer

PRICED AT less than $400, the FotoFun color dye-sublimation printer creates near-photographic-quality 4-by-6-inch prints. The glossy printouts can serve as postcards or they can be baked onto specially coated mugs. The FotoMug Kit costs $30 for four mugs. Fargo Electronics, 7901 Flying Cloud Dr., Eden Prairie MN 55344.

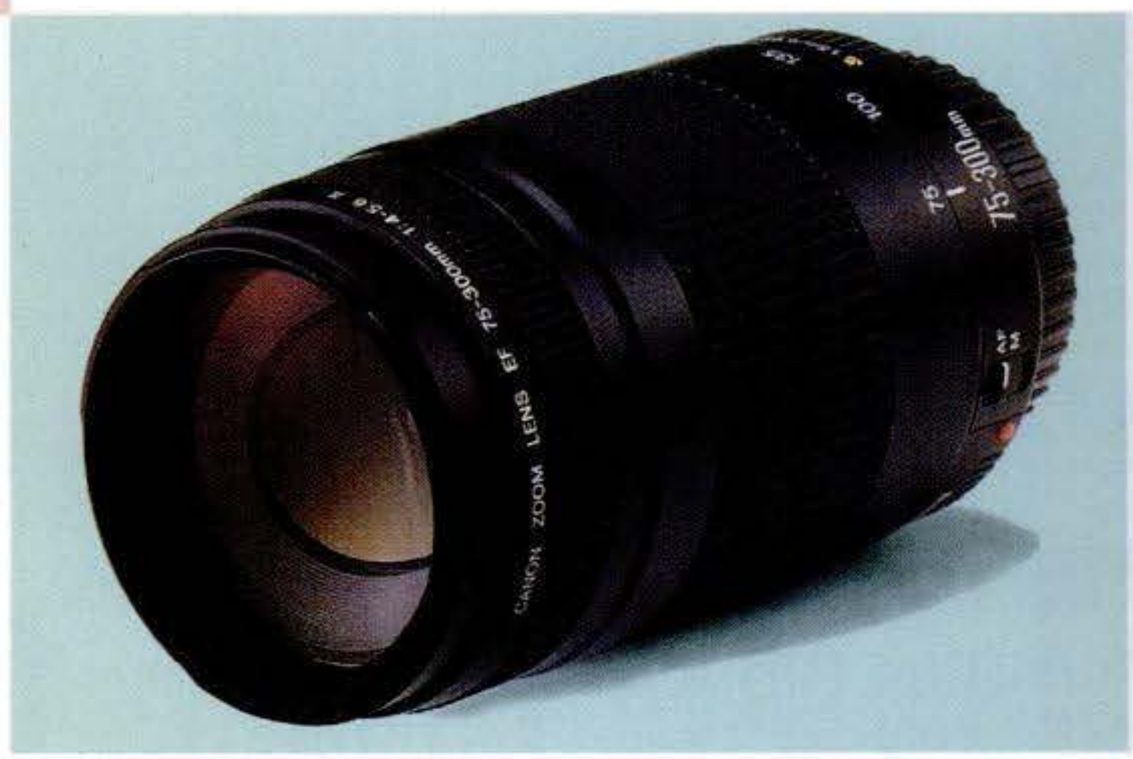


Literacy Miniaturized

SEIKO'S SC-1660 Word-Finder makes a useful desktop companion for writers. The slim thesaurus contains 660,000 synonyms and 55,000 word definitions, and it can check the spelling of 95,000 words. A calculator feature handles chores such as metric-to-English and foreign-currency conversions. Price: about $50. Seiko Instruments USA, 2990 W. Lomita Blvd., Torrance CA 90505.

Shake 'n' Take Lens

APPLYING TECHNOLOGY it had already used for camcorders and binoculars, Canon has produced the world's first interchangeable lens with image stabilization for 35mm SLR cameras. The EF 75-300mm zoom telephoto uses gyro sensors and a lens group to counter camera motion from shaky hands. That lets you select a slower shutter speed than usual, so you can use slower, finer-grained film. Price $920.



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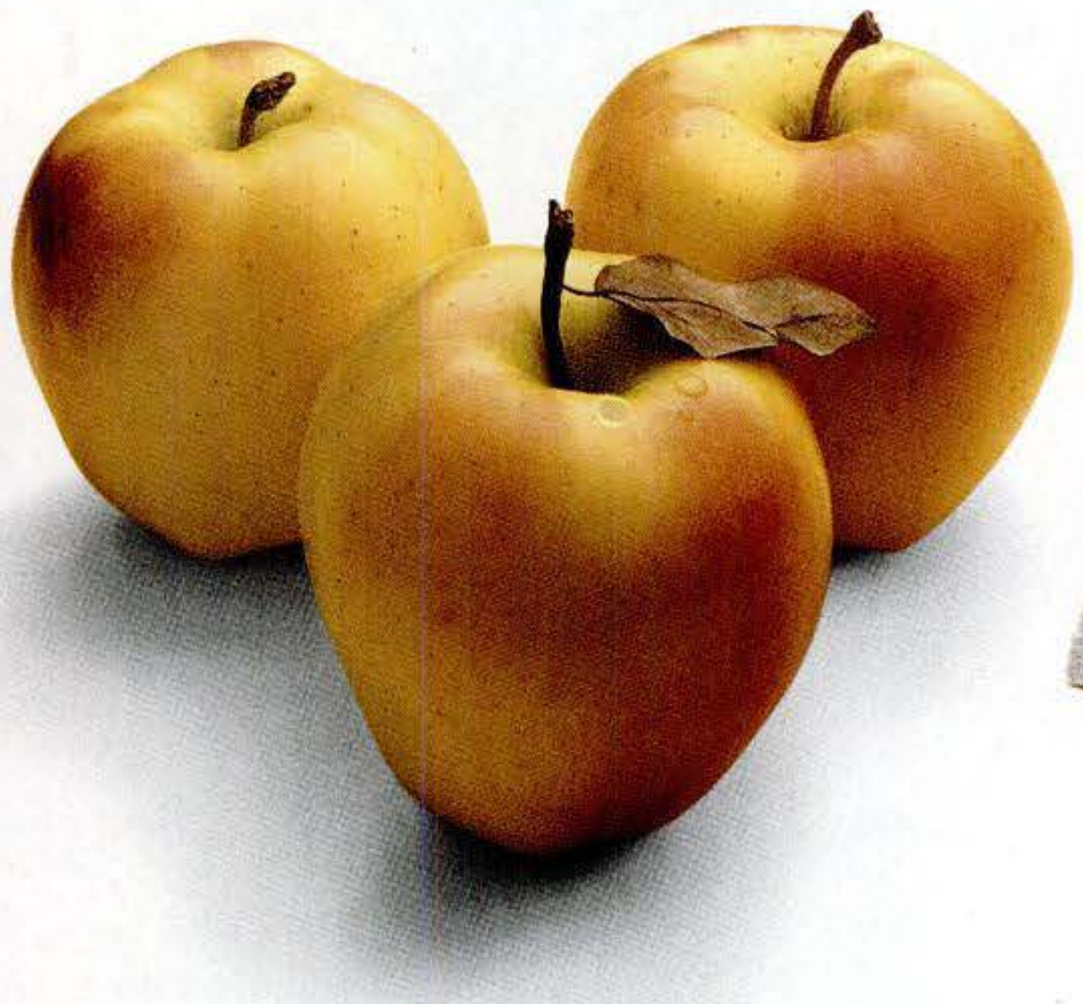
Nature's Gold Series



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Fits great.

Naturally cool
and comfortable cotton.

Found in those big stores
where you buy everything.

Nope.

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Rounding the Edges

A HIGHER, rounder roofline results in one inch more headroom inside Saturn's redesigned 1996 SL2 sedan, claims the automaker. A DOHC 1.9-liter, 124-horsepower four-cylinder engine now features sequential port fuel injection. Dual airbags are standard, and antilock brakes are optional. Saturn's full-time traction-control system is now offered on models with manual transmissions. Base price: $12,295.

Luxury Compact

NOT A LEXUS, but a Leica, the elegant new auto-everything Leica Minilux sports an impervious titanium body with leather trim. But the real attraction is a lens that is remarkably fast for a pocketable 35mm camera—an f/2.4 Summarit with a special coating for saturated color and high contrast. The camera has all the other customary automatic features, including red-eye reduction and autofocus. Price is $995; $1,095 for the date-back model.

Two Programs, One Tape

WITH NEW VCRs from Sharp, you can record two shows airing at the same time—on one tape. With the $1,100 VC-BF80, you can even play back both simultaneously in smaller side-by-side pictures or with a picture-in-picture function. The $965 VC-BF70 allows sequential playback. The VCRs also work in standard VHS mode. Available in Japan.

No Tipping

A BICYCLE helmet can't protect your head properly if it's tipped up off the forehead—a common mistake made by many cyclists. Now Bell Sports' Half-Nelson feature, shaped like an open triangle on a flat stick, rests against the back of your neck to hold the helmet in the proper place. The helmet costs about $40.

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And that's just one spoonful.

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Soup that eats like a meal.®

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Better Take This

Better fasten your safety belt, too. Because the Chevy Full-Size Pickup has an all-new interior. Its form-fitting seats are more comfortable than ever. Leather seating areas are even available if you feel like indulging yourself. The instrument panel is easier to read and easier to use.*

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For a free product brochure call 1-800-950-2438.

ather seating surfaces available in Extended-Cab only. †Always wear safety belts, even with air bags. **Dependability based on longevity: 1984-1993 full-line truck company registrations. Excludes other GM divisions. The Chevrolet Emblem is a registered trademark and Chevy is a trademark of the GM Corp. ©1994 GM Corp. All Rights Reserved. Buckle up, America!

News Sitting Down.

*The optional center console is kind of our answer to the Swiss Army Knife. And, of course, there's a standard driver's-side air bag.† Don't worry. The Chevy Full-Size is still built like a rock. It just doesn't feel that way. Chevy. The most dependable, longest-lasting trucks on the road.***

Chevy Trucks
LIKE A ROCK

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Putting on the Dog

FOR HOT dogging on the slopes, metal edges along the smooth, flat bottoms of model SD 250 Sled Dogs snow skates—they look like ski boots, but you ski right on them—provide a turning and twisting performance advantage. Price: $260. The Sled Dogs Co., 2324 University Ave., Ste. 115, St. Paul MN 55114.

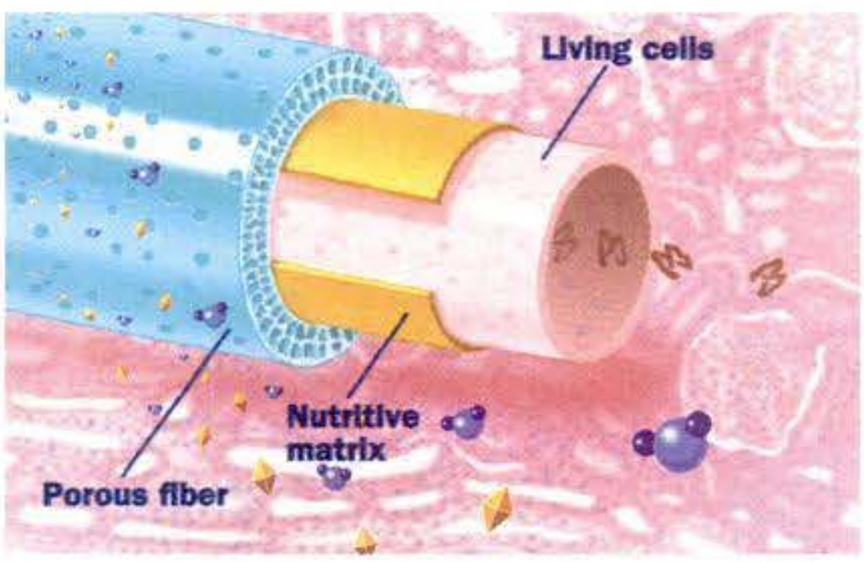
Sound Navigation

IF YOUR TODDLER can make noise, he or she can navigate the interactive book Marty and the Trouble with Cheese. It's the first children's software title that uses sound-recognition technology to control a character's movements. Activities include hide and seek and mimicry. Price: $40. Maxis, 2 Theater Square, Orinda CA 94563.

Bioartificial Kidney

PATIENTS WITH failing kidneys may soon have an option other than dialysis or organ transplant: the world's first "bioartificial" kidney, invented by Dr. David Humes. Lab-grown kidney cells line a filter device. Hundreds of cell-coated filter tubes packed into a cylindrical cassette help reclaim vital blood nutrients, in much the same way as a natural kidney. University of Michigan Medical Center, 300 N. Ingalls, Room N14D10, Ann Arbor MI 48109-0475.

DAN CUTLER, AMI



Energetic Electric Hybrid

WITH A 95-MPH top speed, Mitsubishi Motor's prototype Hybrid Electric Vehicle offers feel-good energy efficiency *and* prospects for pedal-to-the-metal driving satisfaction. Running on the battery alone, the vehicle achieves zero emissions. When stored energy levels fall, a gasoline engine/generator takes over to provide wheel power while simultaneously recharging the battery. The vehicle's driving range is 150 miles on one tank of gasoline.

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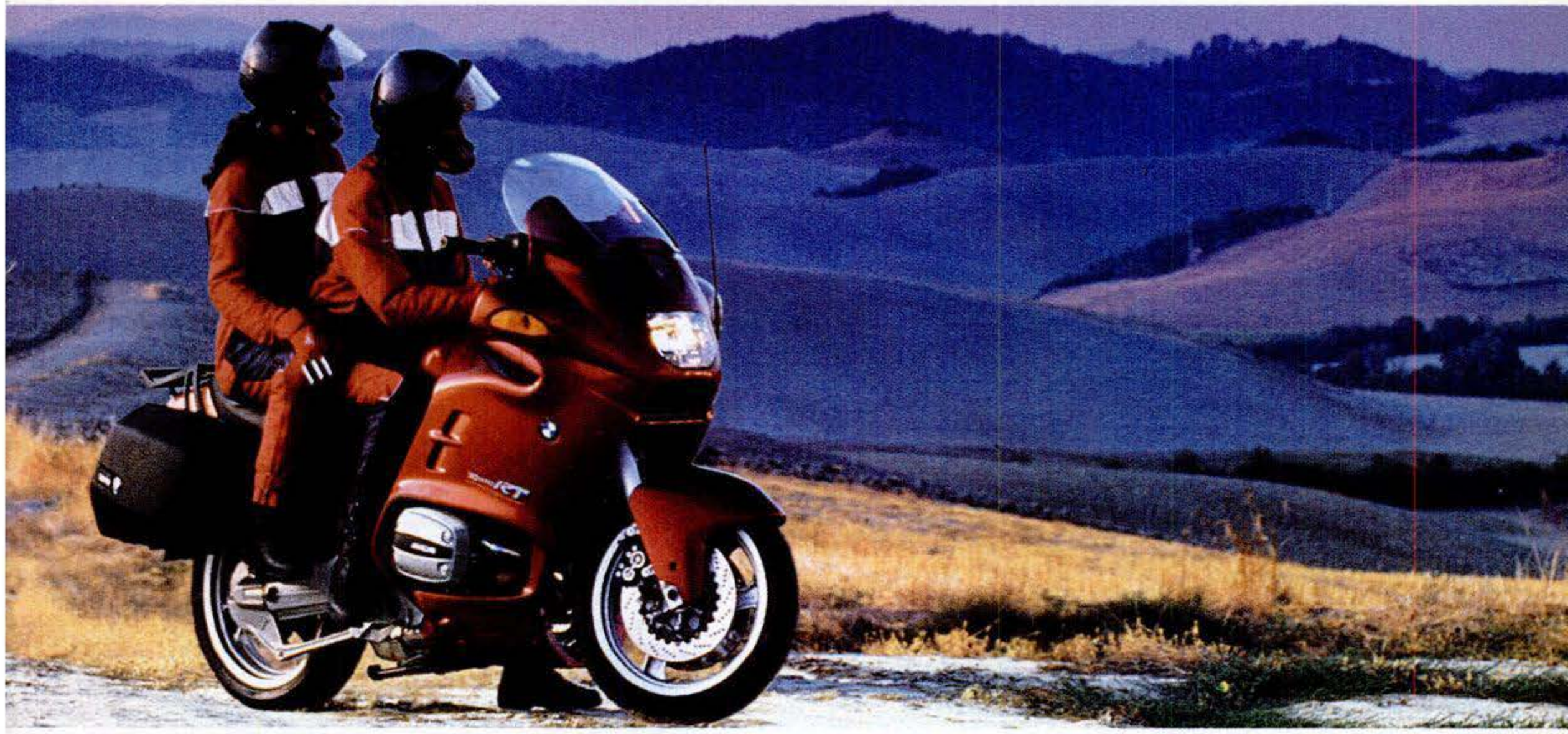
LOOK WHAT OUR ENGINEERS BROUGHT BACK FROM 73 YEARS OF TOURING.



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It's the camera that follows your eye while catching everyone else's.

EOS ELAN IIE fuses high-performance with eye-catching design.

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The Elan IIE is equipped with an advanced, built-in flash. And Canon's exclusive E-TTL flash system, available with the optional Speedlite 380EX, helps to provide a natural balance between subject and background.

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Elan IIE's improved Whisper Drive allows you to rewind film in near silence. Whether you're shooting on the Serengeti or on the sly in your own backyard, there are a number of situations which demand quiet performance — and Canon delivers!

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Thanks. And, with an improved control layout, it's even easier to use. Form and function are truly united in the Elan IIE.

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Watch the Canon Photo Safari on ESPN Saturday mornings this Fall.

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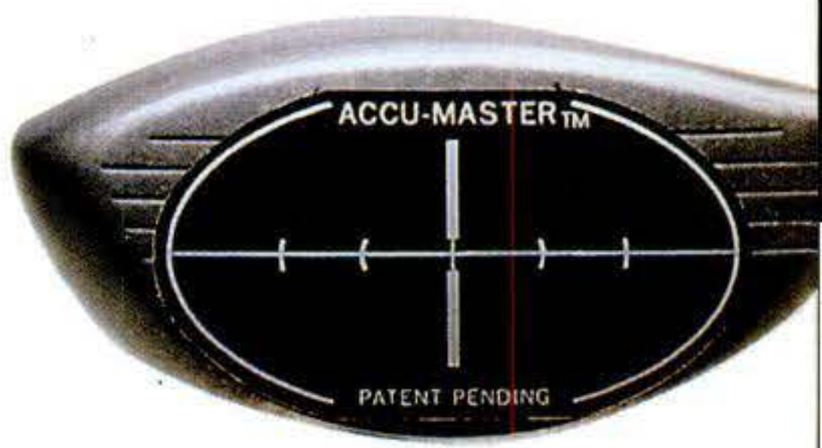
Virtual Climbing

YOU MAY soon be able to substitute the experience of "flying" for dull, everyday stair climbing in your health-club routine. While you pump away on the VR Climber, you feel the wind in your face as you "climb," "dive," and "race" in a virtual world full of other planes, balloons, even UFOs. Price: about $7,000. Tectrix Fitness Equipment, 68 Fairbanks, Irvine CA 92718.

Dial-Up Shades

TURN THE DIAL on the frame of Sundials glasses, and you can adjust the color and density of the lens. The glasses have one set of fixed polarized lenses and a pair of rotatable inside polarizers. The glasses come in six color combinations. Price: $140. Leonardo Vision/Revision, 115 W. Madison, Ann Arbor MI 48103.



Shot Practice

STUCK TO a club face, the Accu-Master liquid-crystal pad lights at the ball-impact point (top)—so golfers can practice finding that sweet spot. The spot fades in 15 to 20 seconds for the next shot (above). A reusable adhesive lets you remove the pad for play. Cost: about $5. ProActive Sports, 25450 S. Cass Rd., Canby OR 97013.

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NEWSFRONTS

HOME TECHNOLOGY

EDITED BY JUDITH ANNE GUNTHER

INDOOR POLLUTION

Stuck in Thin Air

COMMON SENSE dictates that if you want to flush out indoor air pollutants—from cigarette smoke and spores to gases from cleaning products—you should step up a room's ventilation. But that's not necessarily so, says a new study.

Mechanical-engineering experts found that air entering a room through a typical vent flows in turbulently and unevenly. Some of the fresh air rushes through, while some of the stale air already in the room forms stagnant pockets in which pollutants become trapped.

Adrian Bejan of Duke University and Jose Lage of Southern Methodist University used a supercomputer at Cornell's Theory Center to model the movement of pollutants in a room under varying conditions. The two-dimensional simulation predicted how pollutants from a single source, such as a burning cigarette, spread within a room in which air moved from a vent on one wall to another vent on the opposite wall. The scientists also simulated a room in which a contaminant was evenly dispersed.

"Our question was so basic that we thought if contaminant entrapment is a real phenomenon, then we should see it, especially in two-dimensional air-flow," Bejan explains.

In both situations, says Bejan, some of the contaminant remained in stagnant air cells, while new, fresh air flowed around it. These cells, he explains, "are just like the eye of a hurricane. Air in the middle of them just rolls around, and only very slowly diffuses" into the faster-moving airstream.

By repositioning the simulated vents, Bejan and Lage found that the airflow was most effective at removing pollutants when it was directed diagonally at the center of the room. "The air jet has to be aimed at the heart of what would otherwise be one of these persistent cells," says Bejan.

But even more effective, he adds, are rooms equipped with a slow, steady sheet of moving air. For example, relatively cool air could sink through a porous ceiling through a room and out through many vents in the floor. This constant air movement, called laminar flow, is already used in some laboratory clean rooms. Because laminar flow feels less drafty, it is also more comfortable for occupants, says Bejan.—*J.A.G.*

PHILIP ANDERSON

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BUILDING TECHNOLOGY

Structural Steel Framing Gets the Bends

BECAUSE PRICES of framing lumber can fluctuate wildly, some builders now look to steel studs as a substitute. The price is competitive and predictable, and the quality is machine-shop consistent. There's only one problem: The R-value (resistance to heat flow) of steel-framed walls is unacceptably low. In fact, some northern states' building codes penalize the use of such walls. But now a clever steel-stud redesign by architect LeRoy Landers improves steel-stud wall R-values by 16 percent over conventional steel-stud construction.

Landers achieves the higher R-values by simply indenting the steel stud's flanges where the stud contacts the sheathing and walls. Unlike conventional steel studs, whose 1.5-inch flanges sit flush against the wall or sheathing, Landers' studs contact the wall or sheathing only along the stud's vertical edges. Less contact means less conduction (or loss of heat) through the wall via the steel. Two different flange configurations create 1/4- or 1/2-inch air spaces, yielding, respectively, R-10.4 and R-11.1 in 6-inch walls.

Landers claims this design also cuts down on unsightly dust and moisture accumulation on interior steel-stud walls. These blemishes, sometimes called "ghost marks," can form when there are differences in temperature within the wall. (In cold climates, builders often try to minimize this by adding a layer of foam sheathing to the wall.)

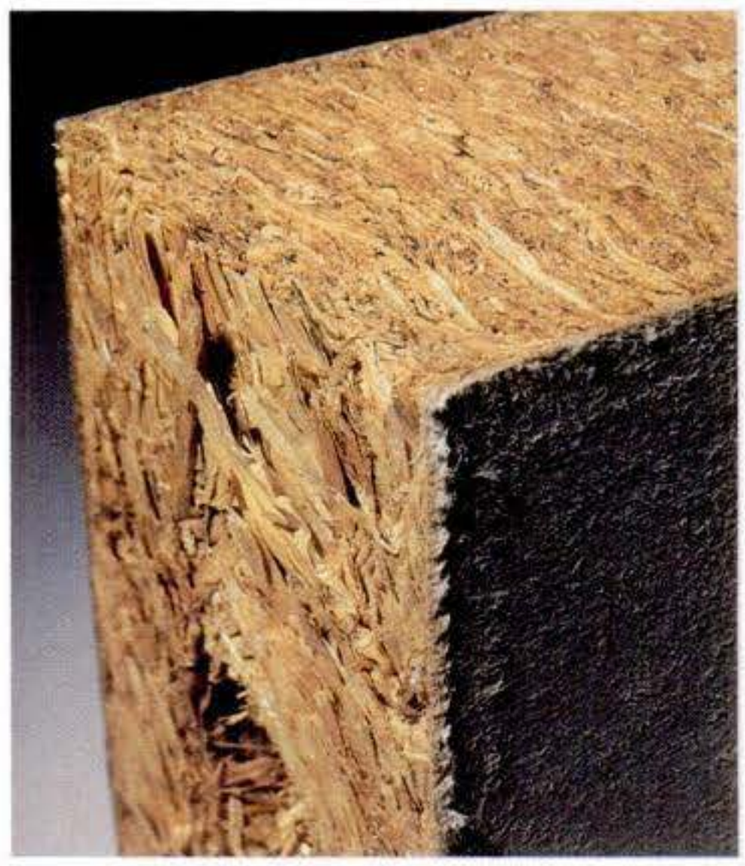
The indented flanges require between four and five percent more steel than conventional steel studs, but Landers is working on a new design that he claims uses 3 percent less steel. That design is currently undergoing structural tests. —*John Wagner*

MATERIALS

Walls, Texas-style

IF THERE'S ONE thing the breadbasket of America has lots of, it's wheat straw. Now a group of farmers in Texas has hit upon a way to turn extra straw into an unusual building material.

The farmers learned of a process developed decades ago in England that presses straw into thick, sturdy "EnviroPanels." The British company, Stramit, licensed the technique to the Americans, who opened a factory in Perryton, Texas, this summer.



JOHN B. CARNETT

Make a wall: straw, baked and compressed.

The factory produces the panels by compressing and heating straw to 500°F, which releases a natural type of resin; this resin bonds the stalks together. Kraft paper is then glued to each side.

Stramit says EnviroPanels, which measure 4 feet long, 8 feet tall, and 2.25 inches thick, can be used as interior wall partitions and ceilings, and for other nonload-bearing applications. Channels within the panels serve as raceways for electrical and plumbing lines.

At $19 per panel, the product is less expensive than conventional stud-and-drywall interior walls, according to Stramit. The solid-straw material also dampens sound better than hollow walls.—*J.A.G.*

TOOLS

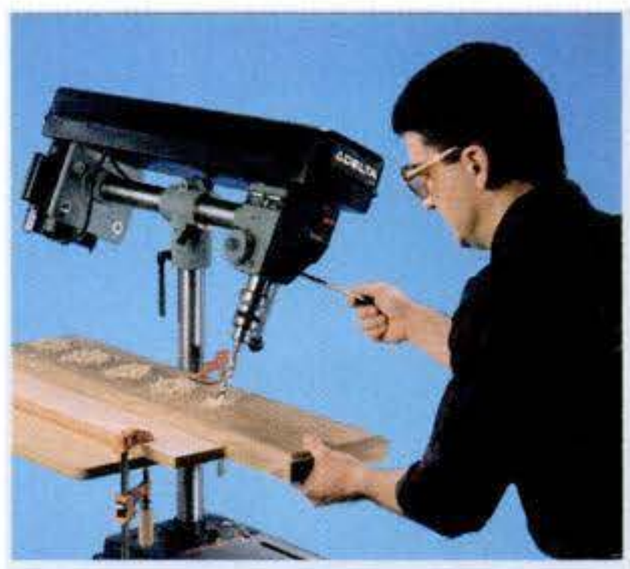
Dexterous Drills

DO YOU THINK of drill presses only as metalworking tools? Some of these machines now have enough twisting and turning ability to satisfy woodworkers.

For example, Ryobi's innovative Wood Drilling System features an oversized, base-mounted table and a head that slides up and down—both features are designed for bulky woodworking jobs.

The table pivots and tilts adroitly. The $400 machine also sports a 500-to-3,000 rpm variable-speed drive, a built-in quick-adjusting hold-down clamp, and a table fence.

Delta and Sears also offer radial drill presses designed with woodworking in mind. On each of these tools, the head is mounted on the end of a horizontal tube so the head can slide outward for drilling at the center of oversized workpieces. The head can be tilted sidewise as far as 90 degrees.



Woodworkers now turn to drill presses.

At about $388, Delta's relatively light, 1/3-horsepower benchtop radial drill has a 1 7/8-inch diameter column and arm; the $290 Sears benchtop model has a 2 5/16-inch diameter column and arm. And a floor model radial drill from Sears, which will sell for about $500, is equipped with a 1-horsepower motor.—*Phil McCafferty*

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There's nothing like your favorite pair of jeans. And there's nothing like the T100. With a 24-valve, 190-horse V6, it has more power than both the Ford F-150 and the Dodge Ram.* But the T100 Xtracab goes way beyond just rugged power. Its sleek styling. Confident handling. Spacious interior. And an extremely comfortable ride make it the first full-size truck to ever boast such intelligent engineering.

In fact, J.D. Power and Associates ranked it the Best Full-Size Pickup in Initial Quality in 1991.** And they've continued to do so every year since.

Check out the Toyota of Big Trucks, the T100 Xtracab. If it's power and sophistication you're looking for in a truck, we've got one in your size.

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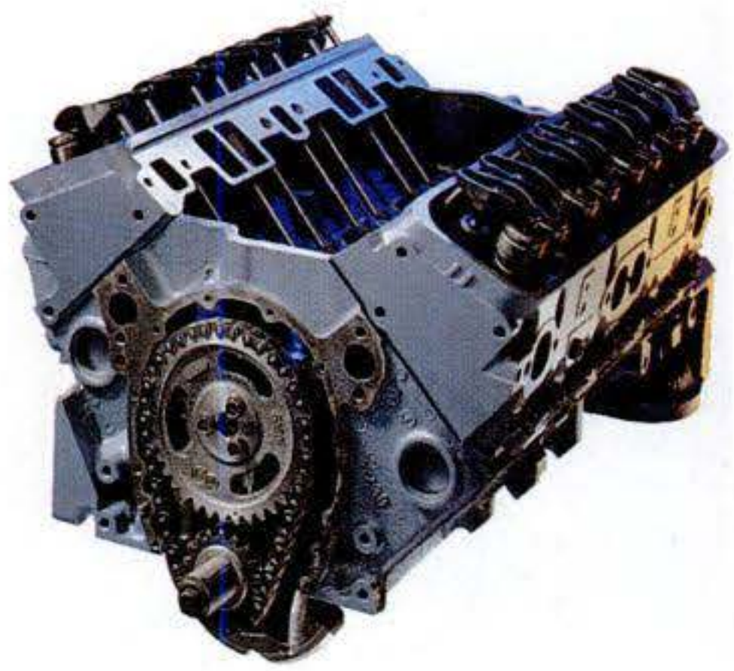
If you're settling for a no-name engine, be sure you buy name-brand shoes.



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AUTOMOTIVE

EDITED BY RICHARD STEPLER

1996 MODELS

Saturn Revival

THE HIGHLY publicized launch of the first Saturn in 1990 proved what any chef knows: The list of ingredients is just the beginning. With an innovative space-frame construction, clean-sheet engine, transmission, and electronics, the early Saturns also proved a trifle coarse riding and more than a trifle noisy. Now comes the 1996 Saturn, with a new thermoplastic body shell on a slightly modified space frame, and with enough tuning, redesign, and refinements to completely transform GM's most prominent import-fighter.

The high-arched profile gives away the secret of the rear seat, which is entered by a wide-opening rear door, and gains hat-on-the-head headroom. The new instrument panel now is integrated nicely into its surroundings, losing the rough edges while remaining one of the few that allows top-entry repair. A touch of the ignition switch ignites a smooth-running engine, without the shakes and buzz of the old model. An extensive road trip, on surfaces from expressway to gravel to potholes, shows off the Saturn's newly compliant suspension and body completely free of plastic squeaks.

Retained is the quick steering response and lively feel, with one of the few drawbacks being a sluggish throttle response that inhibits shifting. The test drive was in a 100-horsepower SL1 version; an optional engine produces 127 hp with twin overhead camshafts.

To meet new emission standards, the engines now feature an OBD II diagnostics system, which was showing its warning lights on the test drive. The new structure adds a cross-member, for rear side impact protection, that folds down when the rear seat is in cargo position.

An intriguing answer to noise transmission through the plastic panels is a layer of Thinsulate cloth bonded to their interior side. So the new Saturn is not only quieter, it also can be skinned out in the frigid Arctic in an emergency to prevent frostbite, should that ever become necessary.—*Dan McCosh*

Saturn's newest sedan: It's been redesigned and refined to better fight the battle of the imports.

MATERIALS

Natural Fibers

FLAX FIBERS left over from the manufacture of fine German bed sheets now find their way into door panels on the new Mercedes E-class, part of an ongoing effort to encourage the use of natural fibers in autos.

Mercedes says the new door backing panels are made from a combination of flax and sisal, fibers that turn out to have considerable impact resistance and light weight. The new panels are being touted as part of a program to use renewable resources as raw material in car manufacturing. Other natural products in the new E-class include coconut fibers and animal hair in the front seat cushions, and cotton fiber sound insulation.

The flax, grown in Bavaria, is comprised of mainly short fibers that are sorted out from the long fibers used in clothing and bed linen manufacturing.—*D.M.*

JONATHON ROSEN

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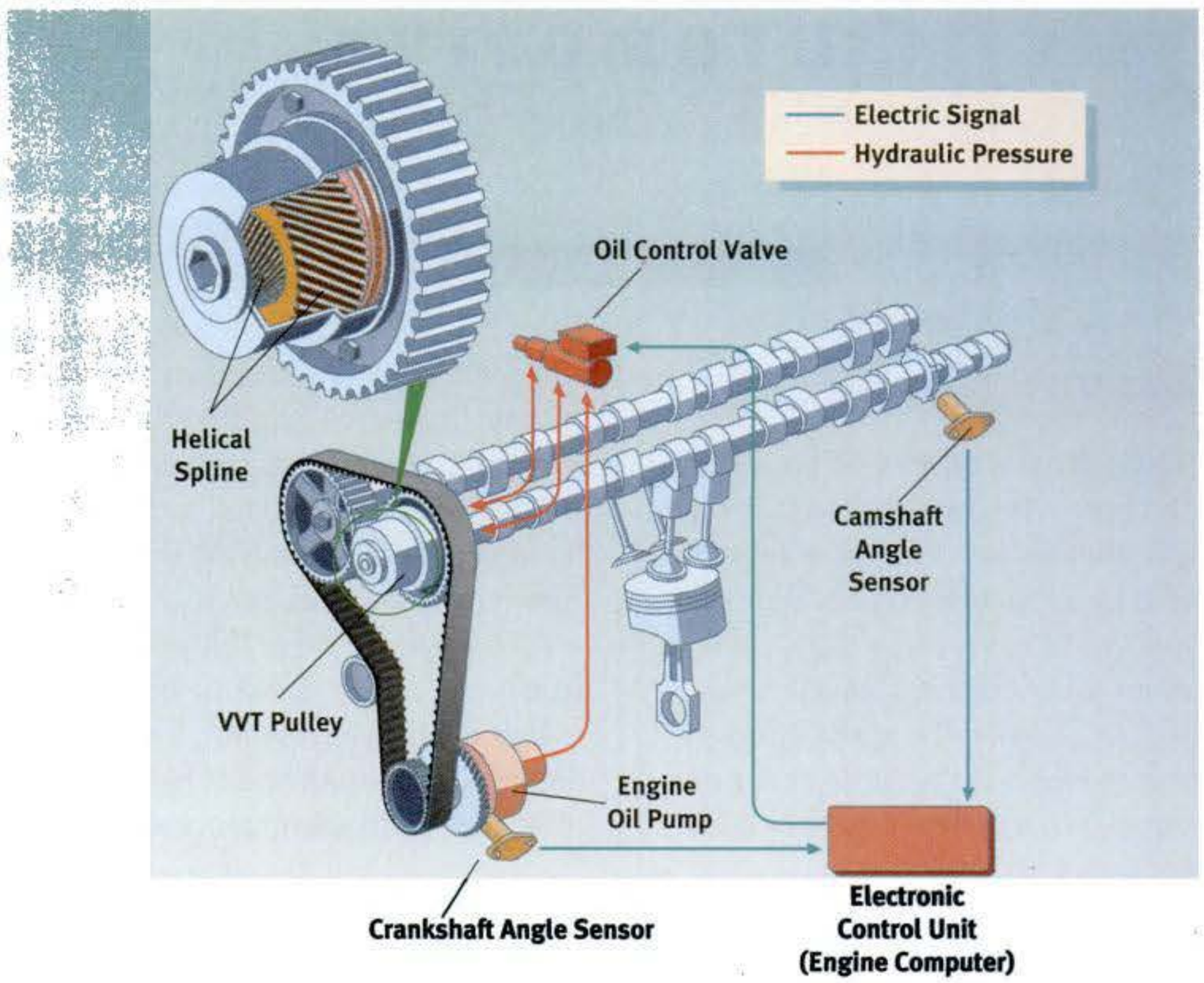
ENGINES

Variable Valve Timing

AN IMPROVED variable valve timing (VVT) system that increases fuel economy by 6 percent and raises low- and mid-range torque by 10 percent has been announced by Toyota. Dubbed VVT-i (for intelligent), the system continuously changes the open/close timing of the intake valves for optimum valve timing based on driving conditions. The company's original VVT system altered the intake valve timing in two steps.

The VVT-i changes the relationship of the camshaft to the camshaft timing belt via a helical gear, with the exact timing altered by varying oil pressure that rotates the camshaft relative to the timing belt. The timing is determined by an electronic control unit. The variable timing acts on the intake side of a multivalve cylinder head, so varying the timing controls valve overlap.

There is no overlap at idle, to stabilize combustion. When the accelerator is not completely depressed, VVT-i increases valve overlap—when the intake and exhaust valves are simultaneously open. This lessens negative pressure in the cylinder to reduce intake loss; reduces combustion temperature to cut NOx; and returns unburnt fuel-air mixture to the combustion chamber to be reburned. At high speeds, intake valve timing is again retarded, to maximize the charging of the combustion chamber for more power.—*R. S.*



ANDY CHRISTIE

This new VVT-i system consists of the engine computer, the oil control valve, and the VVT pulley.

PREVIEW DRIVE

Five valves per cylinder provide better combustion chamber filling.

Audi A4: Fun with Five Valves

THE NEW AUDI A4, which replaces the Audi 90 this fall, is an appealing small sport sedan with all the right moves and a couple of nifty techno-touches.

Tops on the A4's innovations inventory is a new 1.8-liter DOHC, 20-valve 4-cylinder engine. That's correct, five valves per cylinder, a first for a volume-production automobile.

The advantage of an additional intake valve, according to the Audi engineers, is better combustion chamber filling, thanks to optimized valve area in the cylinder head. However, unlike many multivalve designs, the Audi engine isn't designed as a high rpm screamer. Instead, the undersquare (81mm bore by 86mm stroke) design is aimed at improved torque plus better fuel economy.

The 20-valve four-cylinder will be available in normally aspirated (125 horsepower) and turbocharged (150 hp) versions. An excellent five-speed manual transmission is standard.

Although the wheelbase is virtually unchanged from the 90, the A4's body is stiffer, the track is wider, and the basic car is 150 pounds lighter. These changes, plus improvements to the front suspension and the steering, give the car a much more precise and aggressive response than previous models.

Initially, the A4 will be offered with the same 172-hp 2.8-liter, iron-block SOHC V6 that powers the larger A6. The 20-valve four-cylinder engines will arrive in mid-'96. In addition to a solid array of standard safety features, Audi's Quattro all-wheel-drive system will be available.

The base price for the A4 will be $26,500.—*Tony Swan*

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TIRES

Smart Tires for Trucks

"SMART TIRES" for big trucks will tell a computer their serial numbers, their air pressure, and how hot they are, tire-maker Bridgestone/Firestone says. Battery-powered computers built into the tires will broadcast the information to radio-frequency receivers at inspection stations in truck terminals.

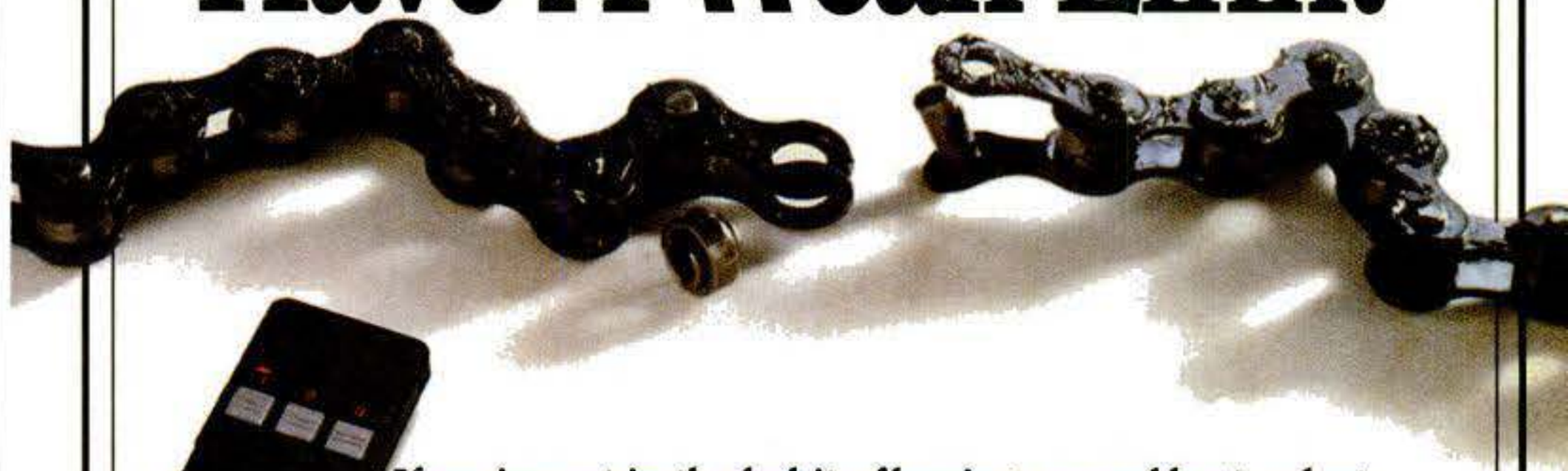
Automatic readings of 18 tires on a normal tractor-trailer and up to 40 on some combination trucks will save drivers a lot of time and may save tires if drivers don't check. When tires run soft, they overheat and may throw off the strips of tread you see beside highways. Tires not soft enough to blow out or throw their treads still wear out faster.

When a truck with "smart tires" passes near a sensor, battery-powered in-tire computers transmit their data to an outside computer hooked to the sensor. The outside computer analyzes the data and warns if any tires need attention. Tires will be identified by serial number and by position on the truck.

The information could save truck owners big money. Ryder Commercial Leasing and Services, which owns about 150,000 trucks, wants to field-test smart tires as soon as they become available.

The in-tire computers will also keep records of the tire's history, which will help when the tire is retreaded. Most truck tires are retreaded several times, but their future use, and therefore the type of tread they can take, depends on their condition. Tires that have never overheated can be retreaded as drive and steering tires. Tires that have never been badly overheated can still be retreaded for use on trailers. But tires that have been badly overheated must be discarded. Retreaders now have to guess the condition of tires.—*Andy Turnbull*

Does Your Garage Door Opener Have A Weak Link?



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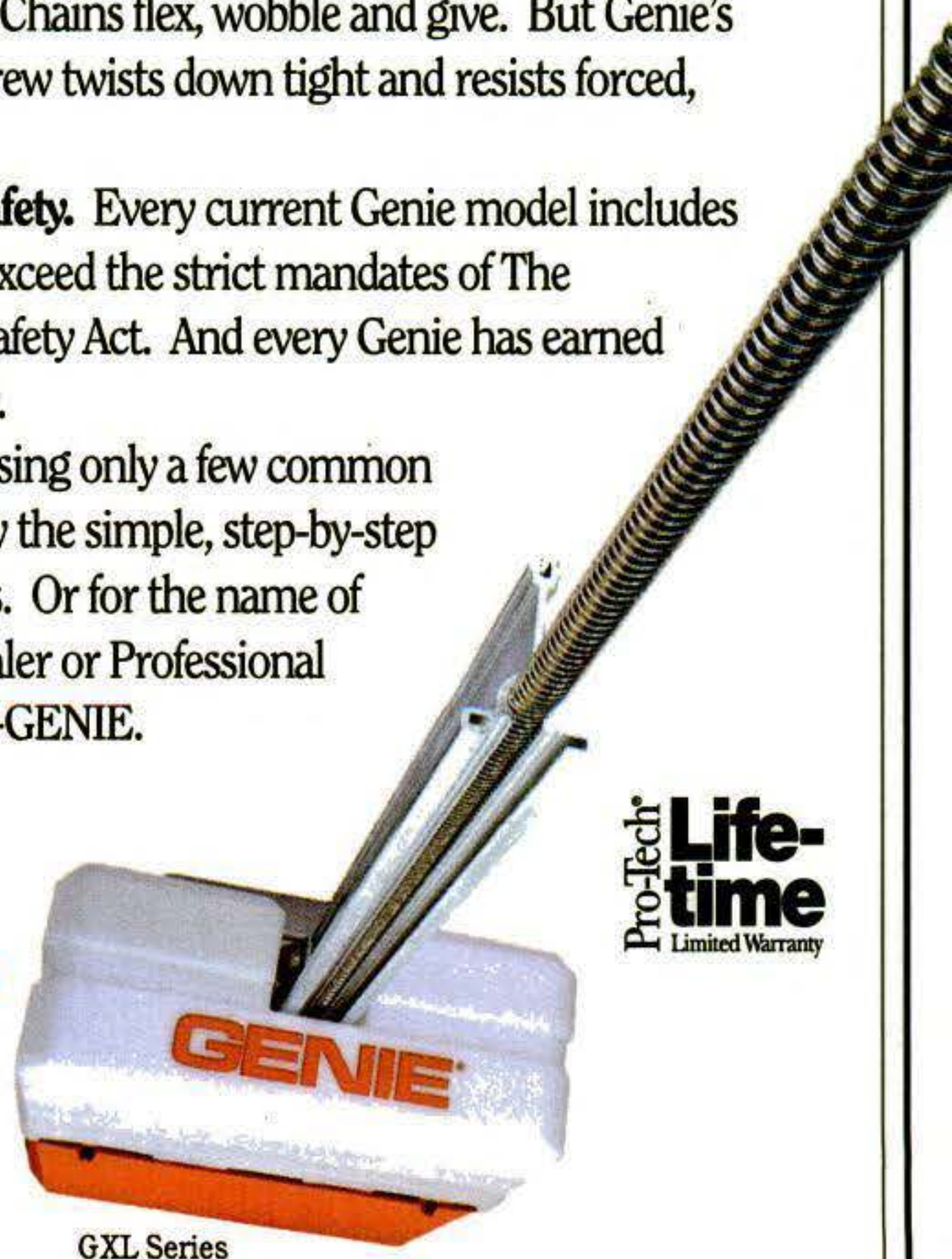

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ALTERNATIVE FUEL

Natural Gas Record

WITH A TIME of 213.7 mph, a Bugatti EB1100 GT set a world speed record for type-approved production cars in southern Italy. What was especially significant was that the car ran on natural gas, as Bugatti used the record-setting runs for a demonstration of its Greengas system.

Greengas, developed by Bugatti Electronics, the advanced research division of the famed supercar builder in Modena, Italy, is a sophisticated system that enables any automotive engine to run on natural gas or propane as well as gasoline. The Greengas-equipped EB110 GT is powered by a 3.5-liter, 60-valve, dual-overhead camshaft V12 that produces well over 600 horsepower on either gasoline or natural gas.

The Greengas system consists of a central electronic control unit with a microprocessor and a gas-injection valve fitted to the original induction system. The system receives information from various sensors, including the oxygen sensor, which measures the oxygen content in the exhaust gases. According to Bugatti, the Greengas software obtains more information from the oxygen sensor than is available in current gasoline engine systems. Using this information, the system calculates and controls the air/fuel mixture for optimum performance, fuel economy, and exhaust emissions. The bottom line is near-perfect combustion for the various fuels—natural gas, propane, or gasoline—so there is no loss in performance.

Besides offering equivalent performance, Bugatti says the Greengas system can reduce fuel consumption by as much as 30 percent, especially under maximum power conditions. The Greengas system also reduces carbon monoxide, hydrocarbon, and nitrous oxide emissions to levels required by the most severe regulations in Europe, the United States, and Japan. Because the system is completely self-regulating, fully adaptive, and does not require calibration, it is ideal for dual fuel applications, allowing practically unnoticed switching from gasoline to the alternative fuel and vice versa. The Greengas system can be used on any Otto cycle engine, and it can also be used on diesel engines converted to gaseous fuels. Other features include an automatic fuel cutoff in case of an accident, and antitheft protection.—*Bill Siuru*

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ELECTRIC CARS

Meeting Resistance

WITH THE California-imposed deadline for zero-emission vehicles now two years away, auto manufacturers working on electric cars say hardware still is unavailable for a fully marketable electric car. Meanwhile, the governor of Massachusetts, one of the states mandating ZEV by 1997, now says he is willing to delay the requirement until proven technology is ready.

This does not mean that U.S. automakers are abandoning their electric vehicle programs. Chrysler is planning an electric-power alternative to its new-generation minivan; Ford has announced that it will electrify its Ranger pickup truck; and GM continues development on the Impact electric sports car.

The three programs represent differing strategies. Chrysler plans to build the electric van alongside its gas-powered vans, while Ford will retrofit the electric powerplant to its trucks. The head of GM's electric car program, however, recently referred to the Impact as a "$350,000 car," a clear signal that the Impact now is considered too specialized and expensive for volume production.

Battery development continues, with true breakthroughs on the immediate horizon. Emerging as the critical factor, however, is cost, rather than performance. Chrysler plans to use a modified lead-acid battery from Electrosource, which uses coated mesh plates to improve the power density. The nickel-metal hydride battery under development by Ovonics Batteries is promised, but early cost estimates are some four times as high as that of lead-acid—in the $15,000 to $20,000 range. The best technology on the far horizon is still lithium-based batteries, but they're even more expensive.

With meetings continuing on the state of the technology, the offer by Massachusetts to delay a mandate until two years after a viable car is demonstrated is seen by many as a way of preventing the introduction of electric cars before they are fully functional—something automakers want to avoid to prevent losing the confidence of the public.—*D.M.*

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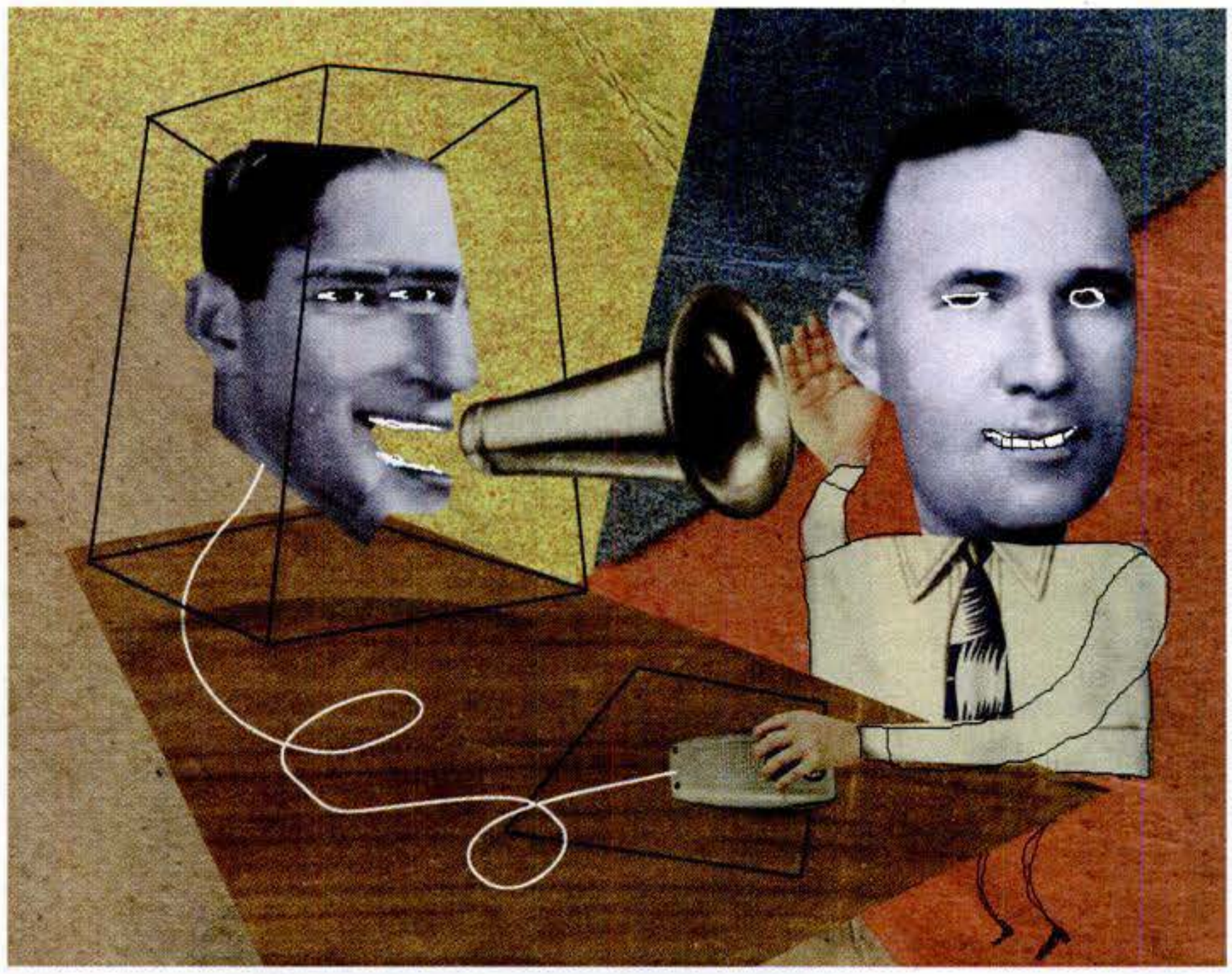

APPLICATIONS

Are You Stumped? Ask Your Software

TIRED OF having to ask friends and coworkers how to use your software? Now you can ask the software.

To help computer users help themselves, several software makers have begun equipping their programs with the ability to solicit and respond to questions in plain English. A basic form of a technique known as "natural language processing," this feature enables you to type in a question such as "How do I change the typeface in this document?" or a plea such as "Show me how to add up the numbers in this column?" The software then responds by calling up the appropriate help screen or directing you to an interactive tutor or "coach" that can walk you through the procedure.

Microsoft's Office 95 collection of programs, which includes Word and Excel, has adopted this technique. It uses an Answer Wizard that lets you type in a query; it responds with a list of "How Do I" topics that lead to step-by-step instructions. More often than not in our experience, the list is topped by the most appropriate subject. Responses usually include a "Tell Me About" list of related topics, too.

Lotus' WordPro has a similar feature called Ask the Expert, which prompts you to complete a "How Do I" question box and then takes you to the right help screen. This feature will be applied to other Lotus applications in the near future, according to the company. Novell says it plans to add the same kind of features to the next version of Perfect Office, due before year end.

Voice recognition may be the next step. Software manufacturers predict you'll be able to ask for help out loud soon.—C.O.

WEB WATCH

Our monthly scope on the worthwhile and weird on the Internet's World Wide Web:

The Smithsonian
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Career listing with real jobs for real people—not just computer geeks.

Genetic Art Slide Show
http://robocop.modmath.cs.cmu.edu:80/interactiveArtII/slideshow.html
A psychedelic parade of DNA images (requires Netscape Navigator).

Music Boulevard
http://www.musicblvd.com
Distortion-free sound clips from your favorite artists.

The Cyrano Server
http://www.nando.net/toys/cyrano.html
A love-letter generator for the nonliterary lovelorn.

Castalia Llamas
http://www.pacificrim.net/~casllama/cllama.html
More than you ever wanted to know about these "loveybears."

Autograph
http://www.io.org/~kennedy/
An ink collector's bonanza without hassling celebrities.

Chinook-Checkers
http://web.cs.ualberta.ca/~chinook
Checkers anyone? This computer opponent is always game.

—compiled by Suzanne Kantra Kirschner, kantra@aol.com

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BEYOND HERE

Hide! You've Got Mail...

BY GINA SMITH

E-MAIL IS ruining my life. And if you don't watch out, it'll ruin yours, too. I wasn't always so paranoid. Like you, perhaps, I once was excited about the quickness, convenience, and sheer modernity of electronic correspondence. There was a time when I looked forward to checking my e-mail, when I couldn't wait to read the quirky comments of my coworkers, when I loved perusing even the most mundane "used couch for sale" e-mails. I proudly told all my acquaintances and business contacts to skip the formality of letters and memos, and just e-mail me.

Several years before it became fashionable, I put my e-mail address on my business card. I was hip.

And stupid, in retrospect. Because now, so many people know my address that I am overwhelmed with absurd and useless junk. This can, and likely will, happen to you, if it hasn't already. And don't think you can just ignore it. Unlike paper mail, e-mail and its senders practically demand immediate responses. If you don't acquiesce, you'll get even more, progressively persistent e-mail. I received one last week with the heading, "I give up." I wish more people would.

Worse still is the coworker who insists on constantly sending you e-mail and then asks you in the elevator or the cafeteria if you read the message about "the meeting." Say you haven't, and he'll just refer you back to your e-mail.

Some say the arrival of e-mail has brought back the art of the letter, or otherwise revived a literary tradition. They say the best writing is happening online, but anyone who's online knows how ridiculous that notion is. As any good writer will tell you, writing is about having something to say and saying it well. Oftentimes, its also about editing and rewriting. There's none of that online. It's either short blurbs or spontaneous and thoughtless diatribes.

Rudeness is common. There's something wrong with a medium that not only tolerates such nastiness, but cloaks it in pseudonym—and even glorifies it as "flaming."

E-mail can be more like Morse code than correspondence. Ubiquitous online acronyms like BTW ("by the way") and FWIW ("for what it's worth")—not to mention those little sideways smiley faces you use to impart emotion when none shows in your writing—demean every literary tradition I can think of.

FWIW, I think every one of these people should GAL ("get a life").

But I'd be careful about saying such things online. There's an illusion of privacy where little exists. People get fired and sued all the time for the juicy (and, they thought, private) e-mail they send. Our e-mail accounts don't really belong to us, we're told. The company owns the computers, so the bosses can read what they process—and forward it. Or, in more public forums, there's the omnipresent fear that online services may be reading your e-mail in the noble interest of filtering out dirty words.

When was the last time someone dared violate the sanctity of mail that comes to you in an envelope?

I remember better days. And I think I see better days ahead. E-mail may be checked by, of all things, technology. The time is very near when we'll see the faces of those we communicate with staring back at us through the computer screen, and hear their voices as they speak. It'll happen in real time with video phone calls, and it'll happen in video e-mail (v-mail?).

FRANK VIVA

All of this audio and video stuff may not do much for literary traditions either, but at least there's more honor in being surly to someone's face—and more shame in wasting someone's time.

Gina Smith is a columnist for the San Francisco Examiner *and hosts a national radio show called "On Computers." One of her e-mail addresses is* GinaSmith8@aol.com.

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ONLINE BANKING

Quicken and Teller

FOR MILLIONS of PC owners, online banking finally becomes a reality with the latest release of the popular Quicken personal finance software. Quicken Deluxe 5 for Windows and Deluxe 6 for Macintosh can provide a direct link between your PC and any of 19 major banks and financial institutions.

Online banking has been in the experimental stage for years. The difference now is that Intuit, the publisher of Quicken, has inked agreements with a host of major financial centers, including American Express, Chemical Bank, Chase Manhattan, CoreStates, Home Savings of America, Smith Barney, and Wells Fargo. Together, they span 36 states representing about 90 percent of the population. Intuit says it will announce more participating institutions by next spring.

The Q-Banking features in Quicken enable you, at any time, to check your account balances, see if checks have cleared, transfer money between accounts, track ATM usage, and manage credit and debit card transactions. The one limitation: There's still no way to get cash out of your PC. But a new online bill-paying service, run by Intuit rather than a third party, lets you pay your bills without writing checks. And there are new investment research and tracking features in Quicken, too.

Quicken Deluxe comes on floppies or CD-ROM and sells for $40 to $60. The Windows edition works with Windows 95 or 3.1.

Quicken is not your only choice. Microsoft has agreements with many of the same banks for its Money program. And two major banks, NationsBank and BankAmerica, recently purchased Meca Software and its finance program, Managing Your Money.—*C.O.*

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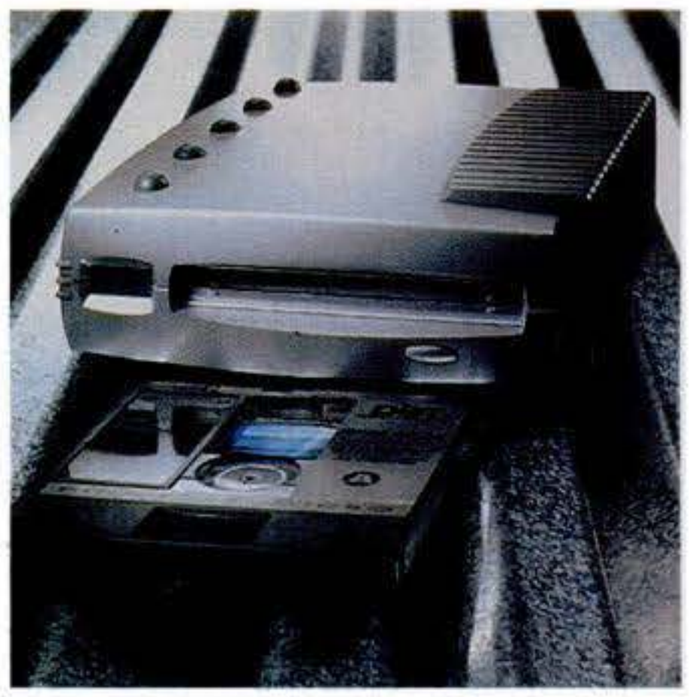

Pinnacle's new Apex drive is an optical leap.

The Optical Alternative

MOST COMPUTER users have never used a magneto-optic (MO) disk drive, but the new Apex drive may be the breakthrough that changes all that.

Pinnacle Micro's new Apex drive writes on removable discs that hold 2.3 gigabytes of data on each side, or 4.6GB in all. That's more than enough to transport (or back up) every bit of data and software in today's most powerful PCs. Put in another disc, and you've got room for another 4.6 billion bytes.

All MO disks are rewritable, like magnetic floppies and hard disks. But previous MO drives stored only 650MB per side. The Apex drive, which is not compatible with earlier MO drives, has recording tracks that are squeezed closer together and a laser that can focus on smaller areas. Apex also has a "direct overwrite" scheme that makes it nearly as fast as a hard disk drive.

By hard disk standards, the Apex drive is pricey at $1,695. But it's cheaper than most ordinary MO drives, partly because it borrows components from hard disks and CD-ROM drives. And while it does cost about twice as much as a 2GB hard disk drive, the Apex has virtually unlimited storage capacity. It also offers the security of being able to remove the disks and lock up your valuable data.—*Hal Glatzer*

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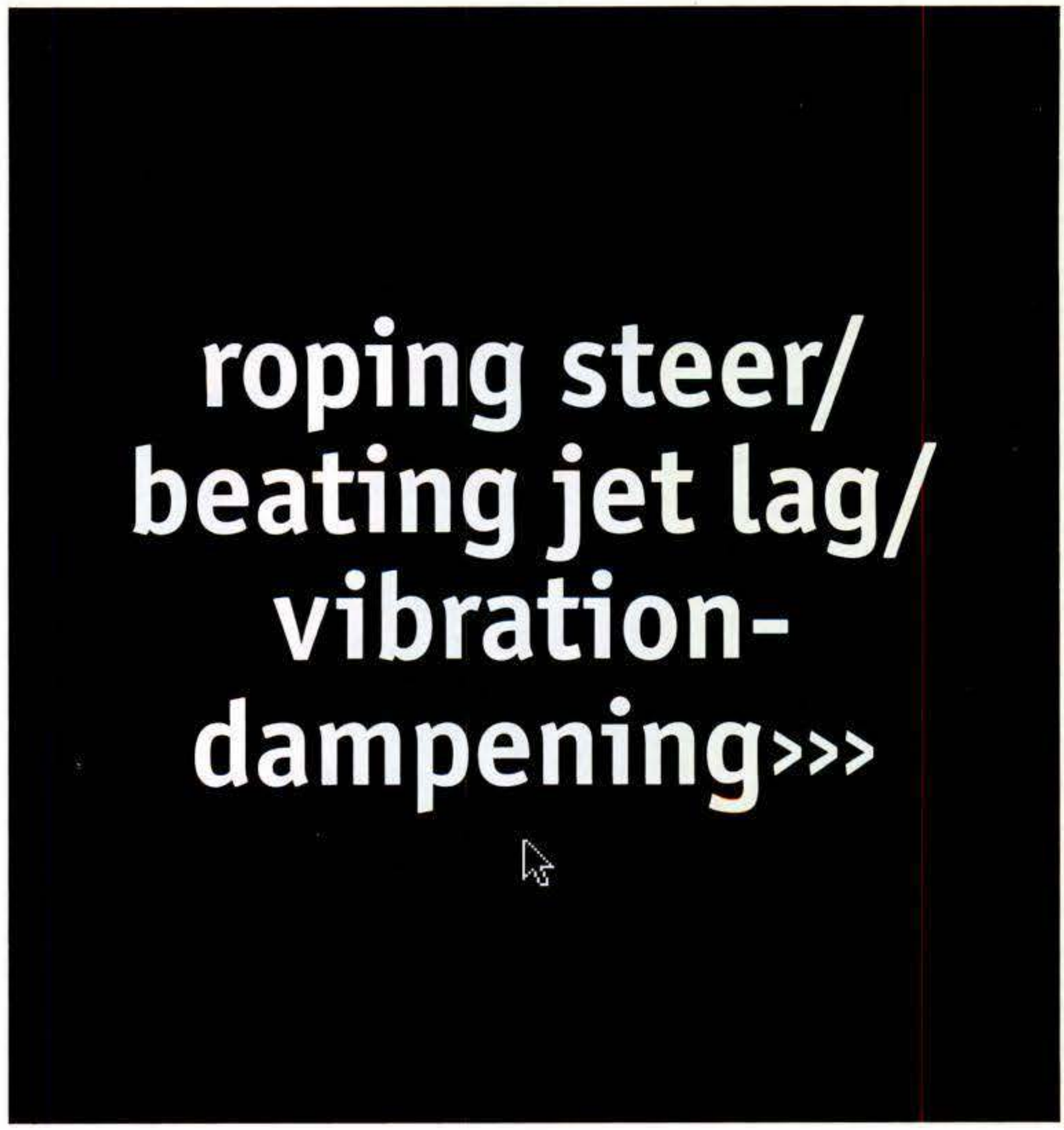
WINDOWS

Picking Up After Windows 95

YES, WINDOWS 95 is a lot easier to grasp than versions gone by. But there's still plenty of room for improvement—and plenty of software publishers ready to provide it.

Many are familiar names. The venerable Norton Utilities, from Symantec, is now available in a Windows 95 edition with revised versions of its Disk Doctor, System Doctor, and UnErase routines, among others. Windows 95 versions of Norton AntiVirus and Norton Navigator are also available. Quarterdeck's QEMM memory manager and MagnaRAM memory-expander utilities now come in Windows 95 versions, too.

Microsoft itself is offering a bundle of utilities for Windows 95 called Plus, which includes a task scheduler and pinball game.—*C.O.*



HANDS ON

The New Works

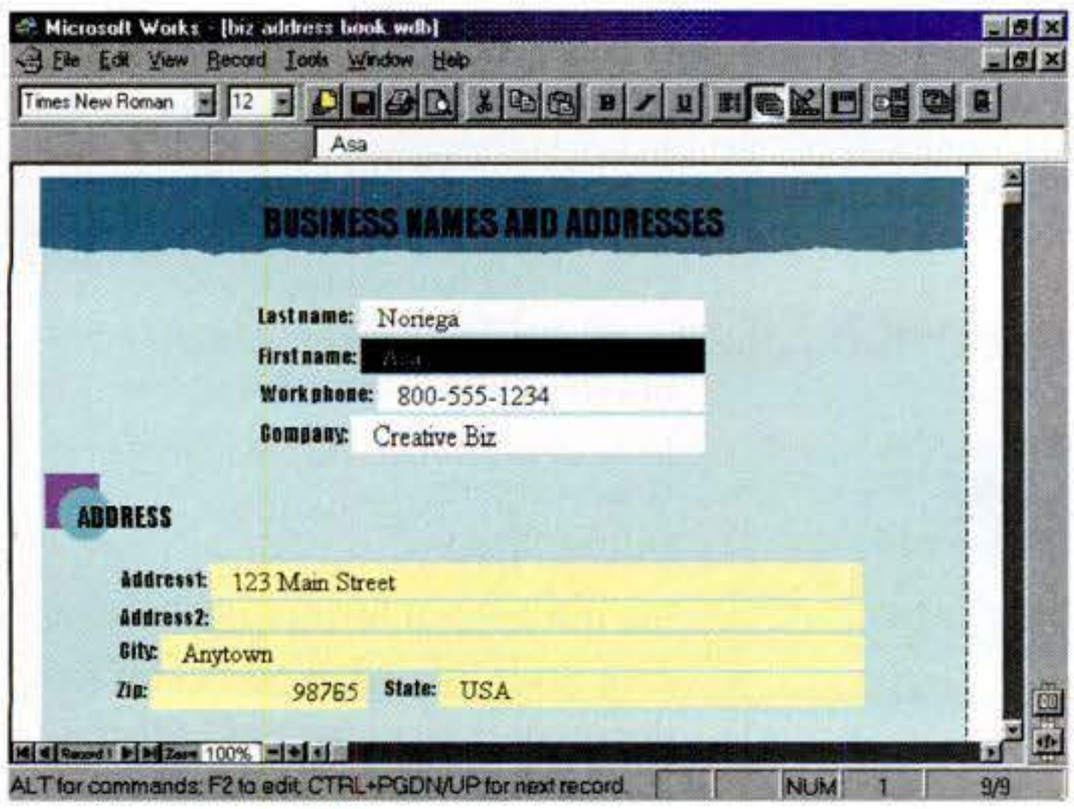
THE BEST value in computer software is the so-called "works" collections that marry word processing, database, spreadsheet, graphics, and other programs into bundles costing about $100. Now they may be the most automatic of software, too.

ClarisWorks 4.0, from Claris Corp., is the most tightly woven of the group and still the best choice if you or your files need to move between Windows PCs and Macs. Version 4.0 runs on Windows 95 or the Mac OS, using the same interface and file format for both. And a host of new shortcuts, including the ExpressStyle feature for formatting documents and the FastReport option for printing out database lists, complement an expanded roster of "assistants" that step you through specific tasks.

Automating tasks is very nearly an obsession in Microsoft's Works for Windows 95. Its new interface is built around a "task launcher," which can take you into existing documents or help you create new ones with the aid of 39 different "task wizards." The wizards step you through the process of creating a business letter, for example, allowing you to customize as few or as many of its features as you like. Microsoft also offers a version of Works 95 that includes its BookShelf reference disc.

PerfectWorks 2.1, from Novell, is less overtly geared around specific tasks, but it does offer several unique new time-saving features, including sophisticated grammar checking and automatic spelling correction. PerfectWorks is designed for Windows 3.1, but it also runs under Windows 95.

All three of the "works" programs sell for approximately $100 or less, and upgrade discounts are available for registered users.—*C.O.*



Microsoft Works has "task wizards" that will step you through jobs such as creating a database of names.

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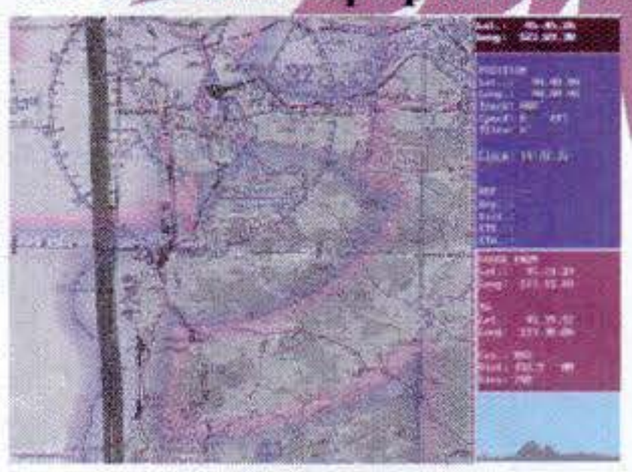

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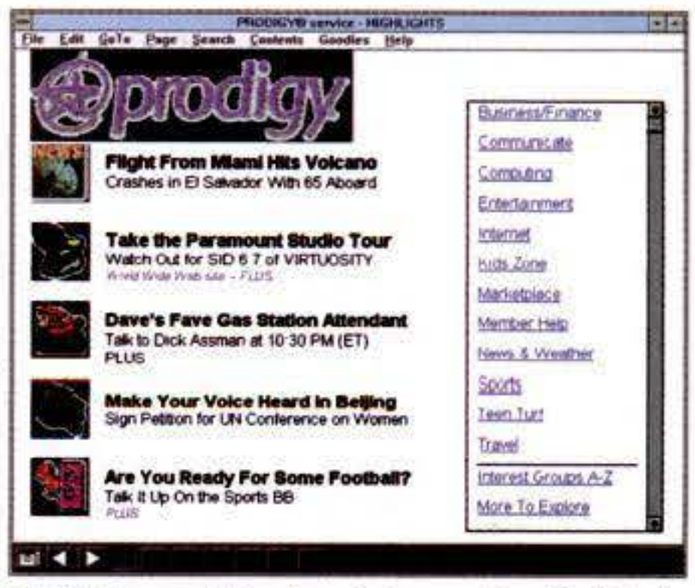
ONLINE

Prodigy Becomes the Web

THE FINE line separating commercial online services and the Internet continues to grow thinner. Prodigy recently became the first online service to adopt the outward appearance—and technological underpinnings—of the World Wide Web.



Prodigy's new interface takes on the Web look.

The completely revamped Prodigy service is constructed with the same hypertext markup language (HTML) used to build Web sites. The move to the Englishlike HTML is significant because it makes it much easier for anyone to provide "content" to Prodigy. Previously, content providers had to code their materials in an arcane language.

One immediate effect of the more open system is that anyone can create a special interest group area on Prodigy using HTML. Prodigy is starting out with 50 such groups, ranging from Chronic Fatigue Syndrome to Flyfishing. Within these areas, you'll find content available only on Prodigy, as well as links to the World Wide Web and Internet newsgroups. As before, e-mail and a Web browser are included.

Both Prodigy and America Online recently began offering ways for their members to create their own Web "home pages" on the Internet. Prodigy lets you do so by simply filling out special forms online, while America Online lets you easily post documents written in HTML format.—*Suzanne Kantra Kirschner*

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MODEMS

28.8 Begets 33.6

WITH CYBERSPACE booming, the need for speed in modems keeps growing. And now 28,800 bits per second (or 28.8Kbps) could be giving way to a new speed limit: 33.6Kbps.

The International Telecommunications Union (ITU) is expected to approve the 33.6Kbps speed as an "enhancement" to the current V.34 standard, rather than a new standard. The formal nod likely won't come until early next year, but several modem makers aren't waiting. U.S. Robotics has already begun sending out software to upgrade its Courier desktop modems to 33.6Kbps. AT&T and Supra are selling new modems that reach the same heights.

How much good it will do is debatable. Noisy phone lines and limited online support for 33.6Kbps will temper any gains.—C.O.

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CD-ROM

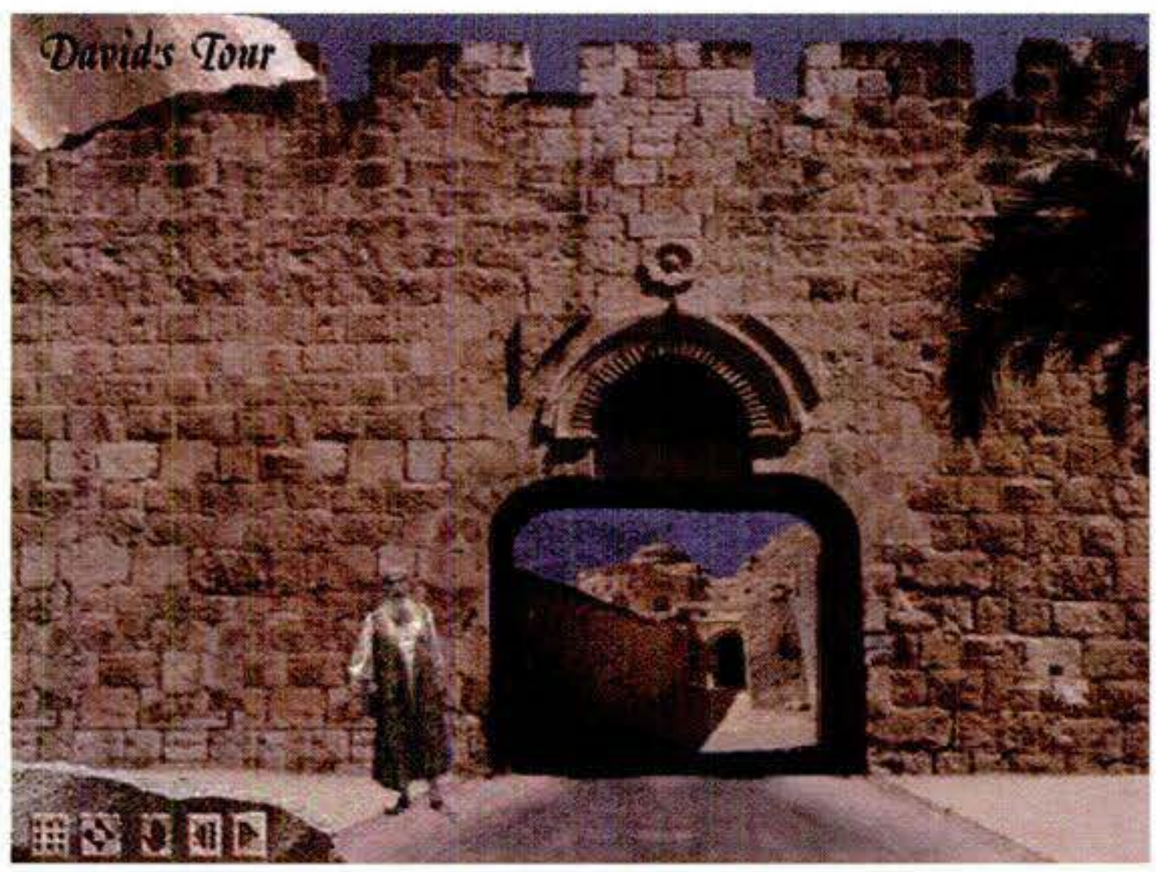
Holy Cities Go Multimedia

HISTORY AND religion could be a deadly dull combination for a CD-ROM disc, but several new titles are taking a decidedly modern approach to ancient times.

The best of the genre so far may be Pathways Through Jerusalem, from Future Vision Multimedia. It presents nine actors playing notable "tour guides" selected from 3,000 years of history in a "Hollywood Squares"-type menu. Click on one, and you'll see a stone-faced King Herod come alive and deride in a Brooklyn accent the adjacent King David: "I built this city and don't let anyone tell you different." Move down a row, and you'll jump ahead a millennium. Click on Dirk, and you'll learn about Jerusalem from a Crusader with a Cockney accent. Choose a guide from the bottom tier, and you'll get one of three contemporary tour guides.

Meant to appeal to users of all faiths, this two-disc set ($70) is strong on secularism with a little vaudeville thrown in. It's not, however, the place to look up a passage from the Bible. Then again, it moves a whole lot faster than a tour bus trying to find a parking space on the Mount of Olives.

Future Vision expects to debut its next title in the series, Pathways To Rome, in 1996. Jasmine Multimedia plans a disc called Inside the Vatican. And, for more ancient history on CD-ROM, there's also The Dead Sea Scrolls ($60) from Logos Research Systems.—*Michael Antonoff*



One of several guides take armchair tourists back through 3,000 years of Jerusalem's history.

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ELECTRONICS

EDITED BY MICHAEL ANTONOFF

VIRTUAL FILM

For *Lawnmower Man II*, an actor in Hollywood appears with digital effects generated in London.

If This Movie Seems Phoned in, It Is

THE CINESITE digital film center in London recently finished work on *Lawnmower Man II—Jobe's War*, a movie about virtual reality filmed in a virtual environment. Perhaps the biggest computer animation project undertaken in Europe, the film was made on two continents linked by phone lines.

While actors in Hollywood performed in front of a blue screen (which produces a blank background), special effects were created in London using Silicon Graphics workstations and sent over Cinesite's dedicated telephone system. The T1 ISDN system consists of 24 lines linked in parallel and allows extremely fast transfer of video-resolution material.

But before the graphic material could be dispatched to Hollywood it had to be compressed. The electronic highway used to transfer images from London has a data capacity of 1.5 megabits per second. Cinesite's T1 system also provided transatlantic videoconferencing so the two production teams could discuss the project live.

The amount of computer-generated onscreen time totals 15 minutes—more than that seen in the movie *Jurassic Park*. Following the success of the Back to the Future Ride at Universal Studios in Los Angeles, the film's producers hope to use the computer graphics scenery as a backdrop for a theme ride and then possibly in a video game. The movie opens January 26th.
—*Wordservice International*

VIDEOCONFERENCING

Just Don't Ask Them To Pass the Salt

BY NEXT Thanksgiving, you could be toasting far-flung family and friends across a video screen—while you sit in a restaurant in your home town.

"Teledining" is the latest twist on videoconferencing—the idea of "meeting" through a video monitor. With its relatively high cost and smallish screens, videoconferencing is mainly done by corporate execs. Instead, teledining uses a wall-size screen for a "they are here" experience; you would rent a teledining suite for two to six people for $70 to $150 an hour—and your "companions" on the other end would do the same.

By next year, TelePort Corp. of Englewood, Ohio, working with IBM Global Network of White Plains, New York, plans to install 120 teledining suites in 40 U.S. cities. With hidden microphones and camouflaged cameras, the suites cost about $150,000. They require 24 phone lines to transmit compressed digital video information. The suites initially will be in hotels and convention centers.

In trying it, I found conversing was almost natural, with an instant's delay.—*Mariette DiChristina*

Teledining Tips

1. Always sit with your good side facing the camera.
2. No matter what you say, finish with the phrase, "Over to you."
3. Never ask the waiter on the other side of the video wall to pour you more water.
4. Determine in advance which side of the "table" is nonsmoking.
5. Speak clearly—the service doesn't include closed captioning.

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It couldn't be easier to qualify to win the Caravan I.Q. Sweepstakes because we've already given you the answers. See, we really did think of everything.

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Test your I.Q. by taking this short quiz. Don't worry, the answers are in the Dodge Caravan Chapter 7 insert you just read.

1. The new Dodge Caravan offers the following V-6 engines–

a) 3.0L V-6 b) 3.3L V-6 c) 3.8L V-6 d) all of the above.

2. The eight-step finishing process on the new Dodge Caravan includes –

a) an anti-chip primer coat b) two separate clear coat applications c) eight steps d) all of the above.

3. The new Dodge Caravan –

a) has a wider stance b) is easier to park c) comes with standard driver and front passenger airbags
d) we've made this too easy, haven't we?

4. If you can think of anything else you'd like to know, you can call 1-800- _____ .

NAME _____ *CITY* _____

ADDRESS _____ *STATE* _____ *ZIP* _____

The New Dodge Caravan
Just as original as the original.™

Official Rules:
(1) No purchase necessary. To enter, complete the official entry form in this ad and mail your entry, or a plain 3"x 5" piece of paper on which you have printed your name, address, zip code and the answers to the questions asked to: Popular Science *Caravan I.Q. Sweepstakes, P.O. Box 7936, Melville, NY 11775-7936. Each entry must be complete and be received by December 31, 1995. Mechanically reproduced entries will not be accepted. (2) Grand Prize (one): A Camcorder and VCR package (est. retail value $1,200). Grand Prize winner will be randomly selected from among all completed entries received. Drawing will occur on or about January 12, 1996 by National Judging Institute, Inc., an independent judging organization, whose decisions are final on all matters relating to this sweepstakes. Odds of winning are dependent upon the number of completed entries received. Prize will be awarded and winner will be notified by mail. Prize is nontransferable and no substitutions are allowed. Sponsor and its agencies assume no responsibility or liability for damages, losses or injury resulting from acceptance or use of prize. Taxes, if any, are the responsibility of the individual winner. Winner may be required to verify address or execute an affidavit of eligibility and release within 14 days of notification attempt or the prize may be forfeited and an alternate winner will be selected. No responsibility is assumed for postage due, lost, misdirected, illegible or late entries or mail. Entry constitutes permission to use winner's name and likeness for publicity purposes without further compensation except where prohibited by law. (3) Sweepstakes open to U.S. residents who are licensed drivers 18 years of age or older as of October 9, 1995, except employees (and members of their families) of Times Mirror Magazine, Chrysler Corporation, Chrysler Corporation product dealers, their affiliates, subsidiaries, advertising, public relations and merchandising agencies, and Don Jagoda Associates, Inc. This offer is void wherever prohibited, and subject to all federal, state and local laws. (4) For the name of the winner, send a stamped, self-addressed envelope to:* Popular Science *Caravan I.Q. Winners List, P.O. Box 7539, Melville, NY 11775-7539.*

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We thought of everything.

Chapter Seven

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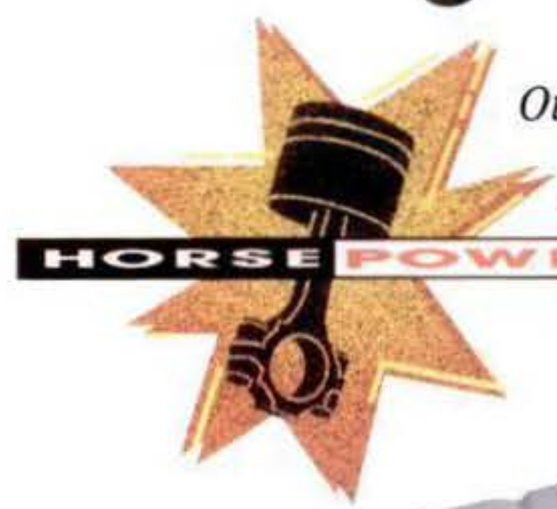
With the new Caravan's available driver-side sliding door, you can spend less time running around. A lower step-up height adds to the convenience.

The new Dodge Caravan's wider stance and more horizontal steering column result in an improved car-like feel behind the wheel.

Some features you'll appreciate right away,

The new Caravan offers a personal alarm system that you can turn on or off by remote control.



Our available 166-horsepower 3.8L V-6 gives you an extra measure of confidence when merging onto the freeway.

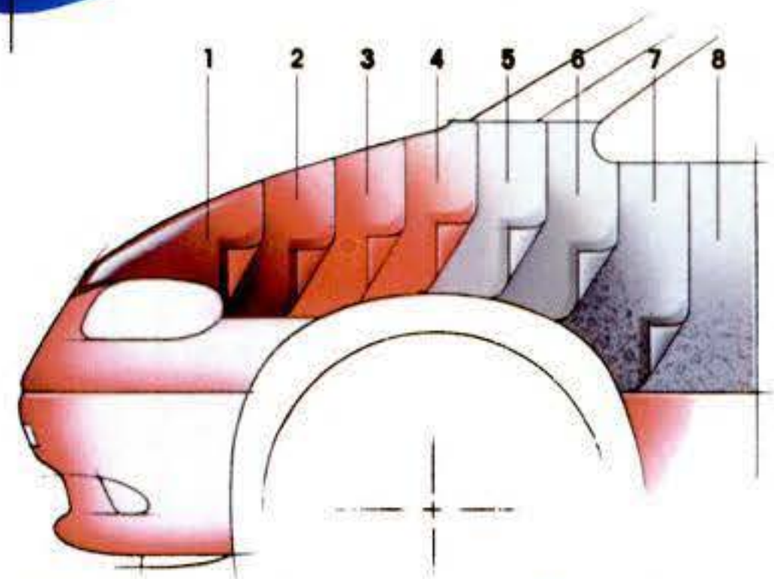
The first time you load the new Caravan, you'll notice it has lots more room. And with more cubby spaces and storage areas, it packs more efficiently, too.

A lightweight aluminum cross member cradles the independent front suspension. At the attach points, tuned rubber isolators are used to give Caravan an even smoother ride.

Anti-lock brakes, which help you brake and steer your way out of danger, are standard, as are driver and front passenger airbags.

When you head out on a long trip, you'll appreciate the smoother shifts of our new available interactive cruise control.

A significantly shorter turning circle makes the new Caravan easier to park.

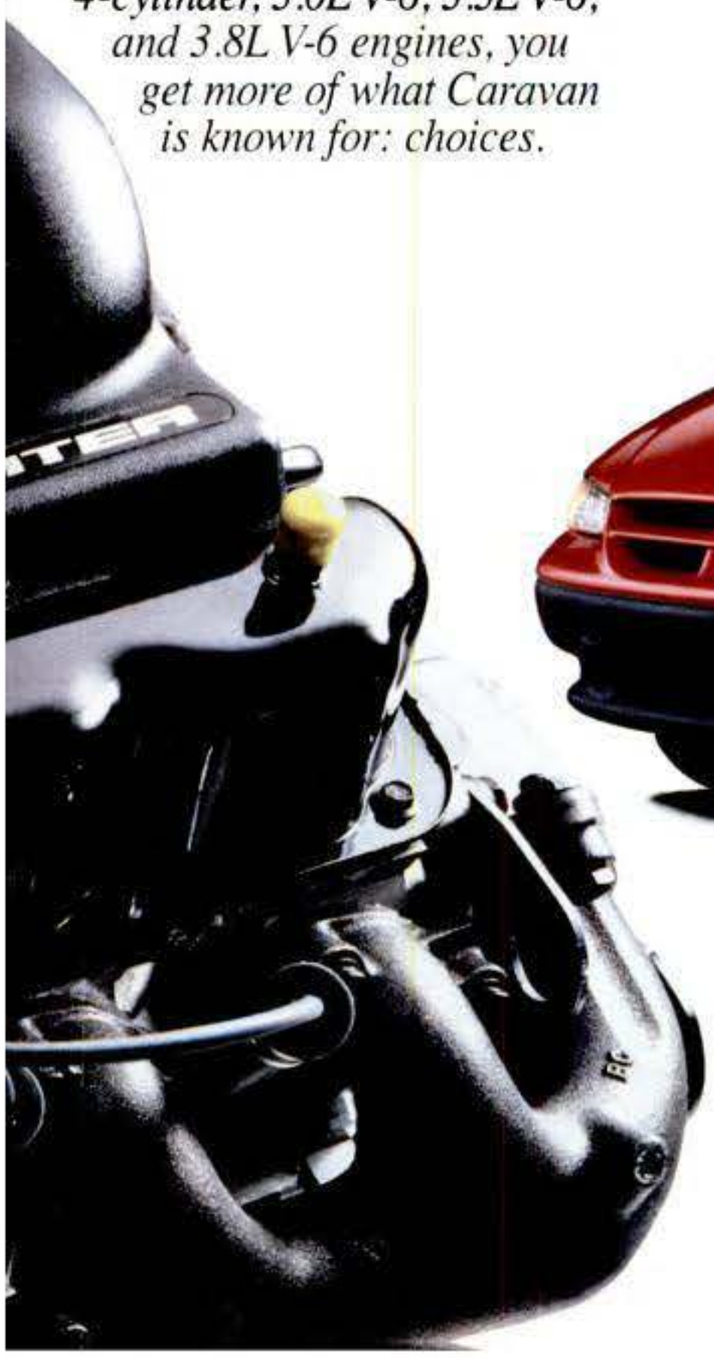


Our highly protective, eight-step finishing process includes a full-body powdered anti-chip primer coat and two separate clear coat applications. All of which means you should be admiring Caravan's brand-new look for years and years.

others will take 100,000 miles.

Our available 3.3L and 3.8L V-6s are so advanced, they can run 100,000 miles before a scheduled tune-up.

With our 2.4L DOHC 4-cylinder, 3.0L V-6, 3.3L V-6, and 3.8L V-6 engines, you get more of what Caravan is known for: choices.



*The new Dodge Caravan is backed by our Customer One Care™ 3-year or 36,000-mile bumper-to-bumper warranty and 3/36 Roadside Assistance. Plus, there's a 7-year or 100,000-mile outer body rust-through warranty on top of that.**

The New Dodge Caravan

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Always wear your seat belt.
**See limited warranties & restrictions at dealer. Excludes normal maintenance & wear items.*

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CAMCORDERS

Debut of the Digitals

DIGITAL videocassette cameras have arrived, and they deliver higher-quality images and sound than today's best Hi8 and SVHS camcorders. And considering they range in price from $2,700 to $4,700—compared with about $500 for an entry- level camcorder—they'd better.

Sony's one-CCD model with a tape.

Panasonic, with its PV-DV 1000, and Sony, with its DCR-VX1000 and DCR-VX700, are the first out.

The most noticeable difference between traditional analog camcorders and the new digital ones is image clarity. The Sony DCR-VX1000 uses three CCDs (charged-coupled devices) instead of one. With three 410,000-pixel CCD pickups working simultaneously, it can record at 25MB per second and play back 500 lines of horizontal resolution, or about 50 percent more than a TV broadcast. Sony's lower-cost model, the DCR-VX700, has one CCD and displays 400 lines. Panasonic uses three 270,000-pixel CCDs to achieve about the same resolution.

Audio has also improved; all models are able to record four tracks of 12-bit sound. This lets you record a stereo sound track and dub a second stereo track. Panasonic's model can also record two tracks of 16-bit, or CD-quality, sound.

Other common features include 20X digital zoom, a still-photo mode, image stabilization, and complete manual override. The viewfinders also have the highest resolution to date, displaying 180,000 pixels.

Battery life for all three cameras is about one hour, or the play time of one full-length digital videocassette. The cassettes, about one-twelfth the size of a full-size VHS tape, come in 30- and 60-minute lengths and cost about $13.

There are some drawbacks, however. Direct digital jacks for dubbing aren't part of the Panasonic model, though you can copy tapes via analog connections. (Sony's models include digital connections.) Also keep in mind that while your new camcorder might output 500 lines of resolution, your TV may not be able to display that many. Still, these issues will probably not deter video enthusiasts.

ERGONOMICS

Backache Relief

DOES THE very idea of a long-distance airline flight make your back ache in anticipation? Northwest, JAL, United, USAir, and American Airlines will install a product called the BackCycler CPM on aircraft in early 1996. The $200 device, which manipulates the lumbar spine area with pneumatic cushions, is the first lumbar support approved by the Food and Drug Administration as a medical device.—*M. D.*

INSTANT REPLAY

Play it Again, Sam

HOW MANY times have you absent-mindedly watched a TV show or listened to a radio report only to pick up the tail end of something interesting enough to make you wish you had been paying more attention? Now, a TV maker has unveiled a product, and a pair of inventors have patented an alternative technology, designed to help you retrieve a broadcast you just saw or heard but didn't quite catch.

Magnavox has introduced a feature called Instant Replay that enables you to review the last four or eight seconds of video—without a VCR. Some of its new TVs include a 4-megabit (500K) solid-state memory buffer that lets you play back a jerky moving image. So you won't have to rely on a sportscaster to relive that just-completed play, for example. Instant Replay is viewed—albeit silently—in a window within the larger picture. The feature, part of an options package, adds about $100 to the price of a set. It should be available this fall in nine of Magnavox's 27- and 32-inch models.

Meanwhile, Detroit developer David Newman and his partner, an Israeli electrical engineer named Aharon Yifrach, claim a U.S. patent for a technology called Second Time Around that uses memory chips to retrieve the most recent audio stream received by a radio.

Newman sees car radios as a likely candidate for such a feature. He suggests that a driver who is daydreaming or distracted by noise may be unaware of a traffic or weather report coming over the radio. Second Time Around would enable the driver to press a button and listen to at least the last 30 seconds of the broadcast. Newman, who has approached several carmakers about using the technology, says the product is not yet available.—*M.A.*

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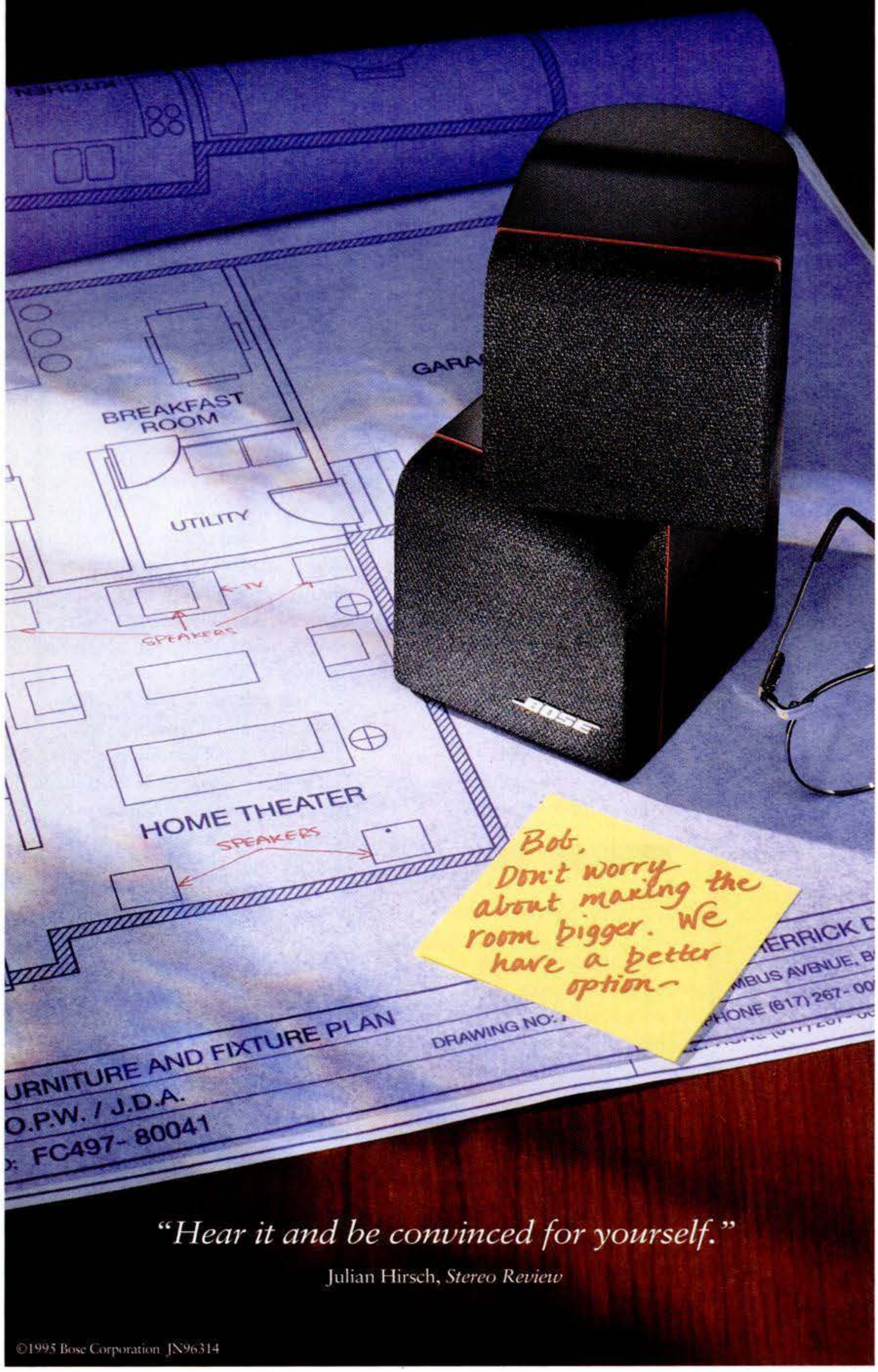
Home theater audio you won't have to build a room around.



"Hear it and be convinced for yourself."

Julian Hirsch, *Stereo Review*

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SCIENCE & TECHNOLOGY

EDITED BY DAWN STOVER

IMAGING

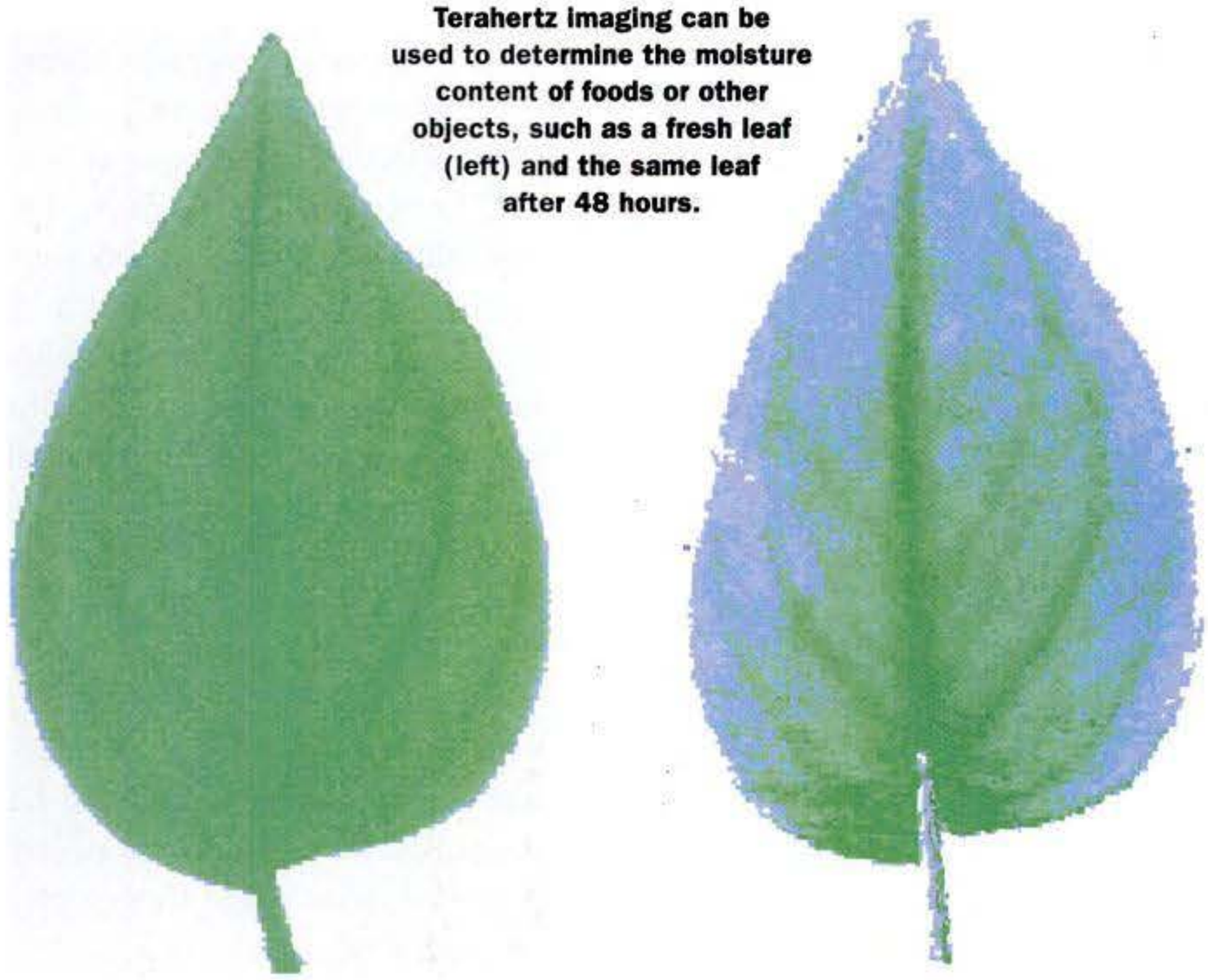
Perfect for Jack Sprat and His Wife

JACK SPRAT, who would eat no fat, might appreciate a new invention from AT&T Bell Laboratories: It's an imaging system that uses ultrashort electromagnetic pulses to determine the composition of food and other objects. For example, the system can tell precisely how much fat is in a slice of bacon, a capability that could be useful to meat inspectors and fussy eaters.

The imaging system works by focusing rapid-fire laser pulses onto a tiny antenna. The antenna responds by radiating electromagnetic pulses, each lasting only a trillionth of a second. These terahertz (trillion-cycle-per-second) pulses, known as T-rays, change in frequency as they pass through the object being sampled. Scientists then analyze these changes in order to determine the composition of the object.

Like microwaves, T-rays are absorbed by water but pass easily through packaging materials such as plastic and cardboard. That makes T-rays useful for food inspection—for example, to determine the moisture content inside a package of cookies. Eventually, T-rays might even help postal inspectors detect letter bombs, or help doctors examine a patient's skin for irregularities in moisture content that could signal the onset of cancer.

Terahertz imaging can also determine the composition of gases. "With this system, you can tell the difference between one greenhouse gas and another," says Daniel Mittleman, who helped project leader Martin Nuss develop the imaging system at Bell Labs. That could make T-rays useful for monitoring emissions from factories and other pollution sources.—*D.S.*



Terahertz imaging can be used to determine the moisture content of foods or other objects, such as a fresh leaf (left) and the same leaf after 48 hours.

AVIATION

Which Way is Up?

PILOTS CALL it "the leans." It's a strong sensation that your aircraft is flying in a steep bank, in spite of what your eyes and instruments tell you.

The leans are just one form of spatial disorientation, the phenomenon once called vertigo. In daylight it's a nuisance. At night or in clouds, it can kill. The Air Force believes it loses 12 pilots a year to spatial disorientation.

Disorientation can occur when an airplane's flight attitude or acceleration changes so subtly that the body's motion sensors in the inner ear do not detect it. The problem cannot be prevented, but it is less likely to kill a pilot who recognizes it when it starts to happen. A new simulator at Brooks Air Force Base in San Antonio, Texas, is designed to give young pilots a safe, high-fidelity taste of the phenomenon.

Like most simulators, the Advanced Spatial Disorientation Demonstrator has a computer-generated visual system. But the cockpit, mounted on a counterbalanced arm, can rotate 360 degrees in any direction. The cockpit "flies" smoothly and slowly to gradually overcome the pilot's sense of balance.

Beginning late this year, all new Air Force pilots will get three 45-minute sessions inside the simulator during their primary training. "We're trying to give you experience of things that you don't want to experience in flight," says Col. Sam Holoviak.

His advice to the pilot who suspects that his head and his airplane are in two different places: "Whoa! Concentrate on your instruments and keep your head very still."—*Bill Sweetman*

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CLIMATE

Ship Trails in the Sky

THIRTY YEARS ago, scientists looking at early satellite images of Earth noticed bright white lines marking clouds above the oceans. They soon realized that these lines were trails left by the smokestacks of large ships.

Once just a curiosity, ship trails may now be useful for global climate research. In a project sponsored by the Office of Naval Research, scientists are studying satellite images and high-resolution photographs of the trails to learn how pollution emitted by ships affects clouds.

Ships often burn "dirty" grades of fuel while at sea, and their smokestacks don't have "scrubbers" to remove pollutants. So particulates in the ship's smoke are injected into the clouds, where they collect water to form small, highly reflective droplets that brighten the clouds above the ship's path.

The bright lines, which can stretch for several hundred kilometers, offer researchers a way to measure the effects of an individual ship's emissions on a relatively clean marine environment. An understanding of these effects could help researchers predict whether larger pollution sources, such as power plants and cities, also make clouds brighter. Some scientists speculate that brighter clouds could forestall global warming by reflecting sunlight.—*D.S.*

MEDICINE

Racing in His Blood

WHEN A FINNISH cross-country skier named Eero Maentryanta won three gold medals at the 1964 Olympics, some competitors suspected him of blood doping—injecting oxygen-carrying red blood cells for increased stamina. Tests showed he had abnormally high levels of red blood cells, but there was no evidence of tampering.

Three decades later, genetic researchers have proven that the skier played by the rules. The researchers showed that Maentryanta and others in his family have a genetic mutation that makes them produce excess red blood cells.—*D.S.*

SPACE

Floating Launch Pad

IN THE SATELLITE business, the cheapest ride to space is atop a rocket launched from the equator, where Earth's rotational speed is highest and provides the greatest boost into orbit. This is one reason the Arianespace launch complex in French Guiana has been so successful.

However, many communications satellites are designed for geosynchronous orbits that are tilted with respect to the equator. And some satellites fly in polar orbits that intersect the equator at right angles. Attaining these orbits requires big rockets that burn a lot of fuel to execute the turn away from an easy equatorial flight path.

A joint venture called Sea Launch, led by Boeing Commercial Space Co., could take business away from Arianespace. Sea Launch will make it easy to reach any orbit—from equatorial to polar—using a movable platform that places a rocket at the best location for the launch.

Norwegian shipbuilder Kvaerner Group is converting an oil-drilling rig into a self-propelled launch pad and designing an assembly-and-command ship to accompany the pad from U.S. ports to launch sites in the Pacific Ocean. Russia's RSC-Energia and Ukraine's NPO-Yuzhnoye are supplying the Zenit rocket and upper-stage motor for the venture.—*Stuart F. Brown*

Rockets that are launched from a self-propelled ocean-going platform could deliver satellites to any orbit.

THE OCEANS

Disposable Dinnerware

A U.S. NAVY AIRCRAFT carrier generates more than nine tons of trash a day. Most of it is thrown overboard.

In 1987, Congress ordered the Navy to develop plans for complying with an international treaty that prohibits ships from dumping paper, metal, or glass near land or in "special areas" such as the Antarctic. The treaty also bans the disposal of plastics anywhere at sea.

The Navy has spent more than $55 million to develop a processor that shreds plastic and melts it into pucks, which can be stored onboard for later disposal in a landfill. But no processors have been installed on ships yet.

Another potential solution is biodegradable, nontoxic plastic. With Navy funding, Army researchers are testing paper cups and trash bags coated with biodegradable plastic, and biodegradable plastic utensils. The products are nearly ready for launch, but their high cost is a limitation.—*D.S.*

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Clockwise from top left, that's Jack Daniel, Jess Motlow, Lem Tolley, Frank Bobo and Jess Gamble. (Jimmy's in the middle).

JACK DANIEL'S HEAD DISTILLER, Jimmy Bedford, has lots of folks looking over his shoulder.

Since 1866, we've had only six head distillers. (Every one a Tennessee boy, starting with Mr. Jack Daniel himself.) Like those before him, Jimmy's mindful of our traditions, such as the oldtime way we smooth our whiskey through 10 feet of hard maple charcoal. He knows Jack Daniel's drinkers will judge him with every sip. So he's not about to change a thing. The five gentlemen on his wall surely must be pleased about that.

SMOOTH SIPPIN'
TENNESSEE WHISKEY

Tennessee Whiskey • 40-43% alcohol by volume (80-86 proof) • Distilled and Bottled by
Jack Daniel Distillery, Lem Motlow, Proprietor, Route 1, Lynchburg (Pop 361), Tennessee 37352
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GENETICS

Eat Your Mutants

CAULIFLOWER looks the way it does because a genetic abnormality hinders the plant's ability to produce flowers. Each bump on a head of cauliflower is an "aborted attempt" to form a flower, says plant biologist Martin Yanofsky.

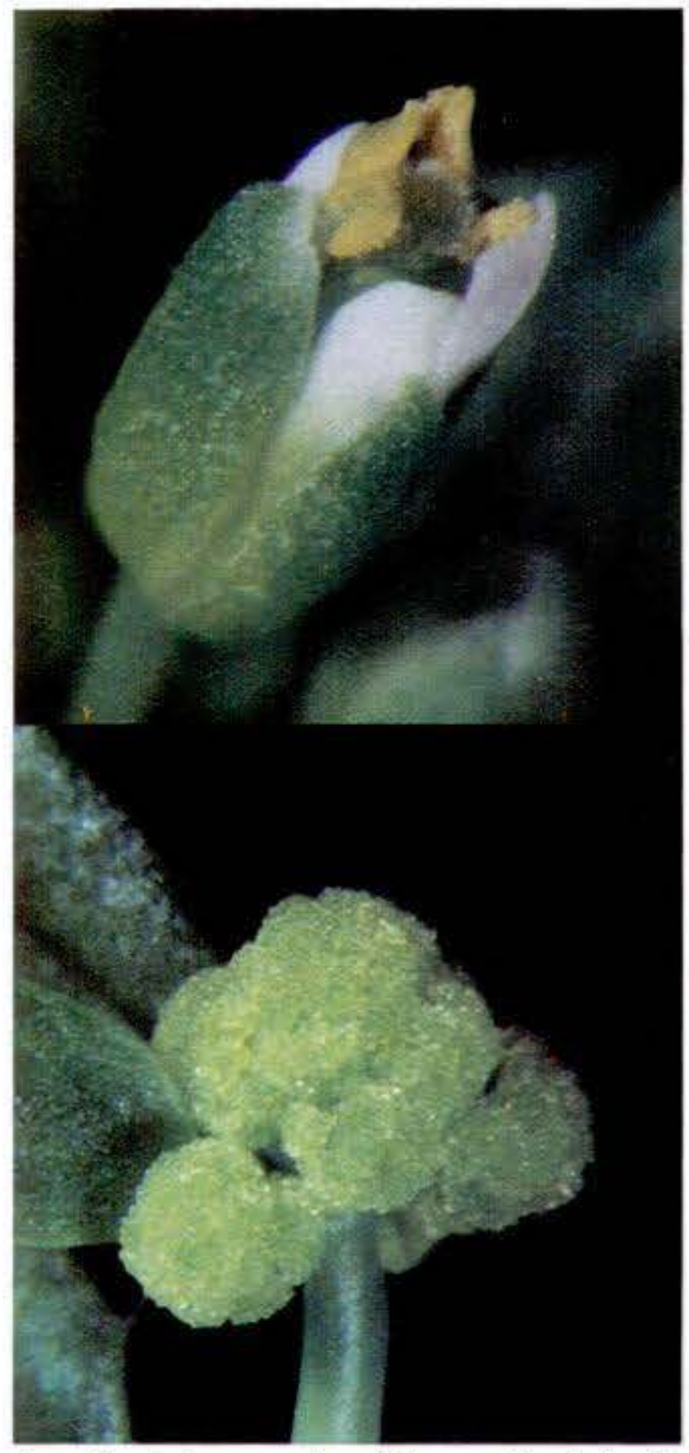
A team of researchers led by Yanofsky at the University of California in San Diego studied abnormal versions of *Arabidopsis thaliana*, a variety of mustard routinely studied by scientists because of its simple genetic makeup. Through natural mutations, Yanofsky's mustard plants had developed cauliflower-like growths at the tips of stems where flowers normally develop.

Yanofsky and his colleagues isolated a gene they suspected was the culprit and dubbed it "cauliflower." To prove their theory, the scientists located a functional version of this gene in a normal *Arabidopsis* plant and introduced it into the mutant plants, which then produced flowers instead of curdlike growths. This demonstrated to the researchers that they had successfully isolated the curd-producing gene.

The researchers then isolated the same gene from a cauliflower plant. As expected, the gene wasn't functional. But a wild, flowering relative of cauliflower has a normal version of the gene.

"The next step will be to take the normal copy of the gene and introduce it to cauliflower," says Yanofsky. That should trigger the vegetable to bloom.

A better understanding of the gene could help commercial growers breed new strains of cauliflower, Yanofsky predicts. The mutant gene might also be inserted into other vegetable plants, such as tomatoes and peas, to make them produce edible curds instead of flowers.—*Judith Anne Gunther*



A mutant gene makes this mustard plant produce lumps (bottom) instead of flowers.

ENVIRONMENT

Bandaid for Oil Spills

A TV SHOW on the *Exxon Valdez* oil spill inspired Floyd Riddell to design and patent an electromagnetic "bandage" that prevents oil from leaking out of tankers with fractured hulls.

A 100-square-foot neoprene diaphragm, the Magna-Patch is held in place by electromagnets. Crews lower the patch using a winch; built-in sonar helps position it.

In tests, the patch turned an 18,000-gallon-a-minute gusher into a five-gallon-a-minute leak. As a result, the American Bureau of Shipping is in the process of approving the patch for fighting spills.

Although the patch could do nothing for a rupture like the one that split the *Exxon Valdez*, Riddell says it could stop the flow of oil in about 70 percent of the cases involving damaged tanks.—*Alton Parrish*

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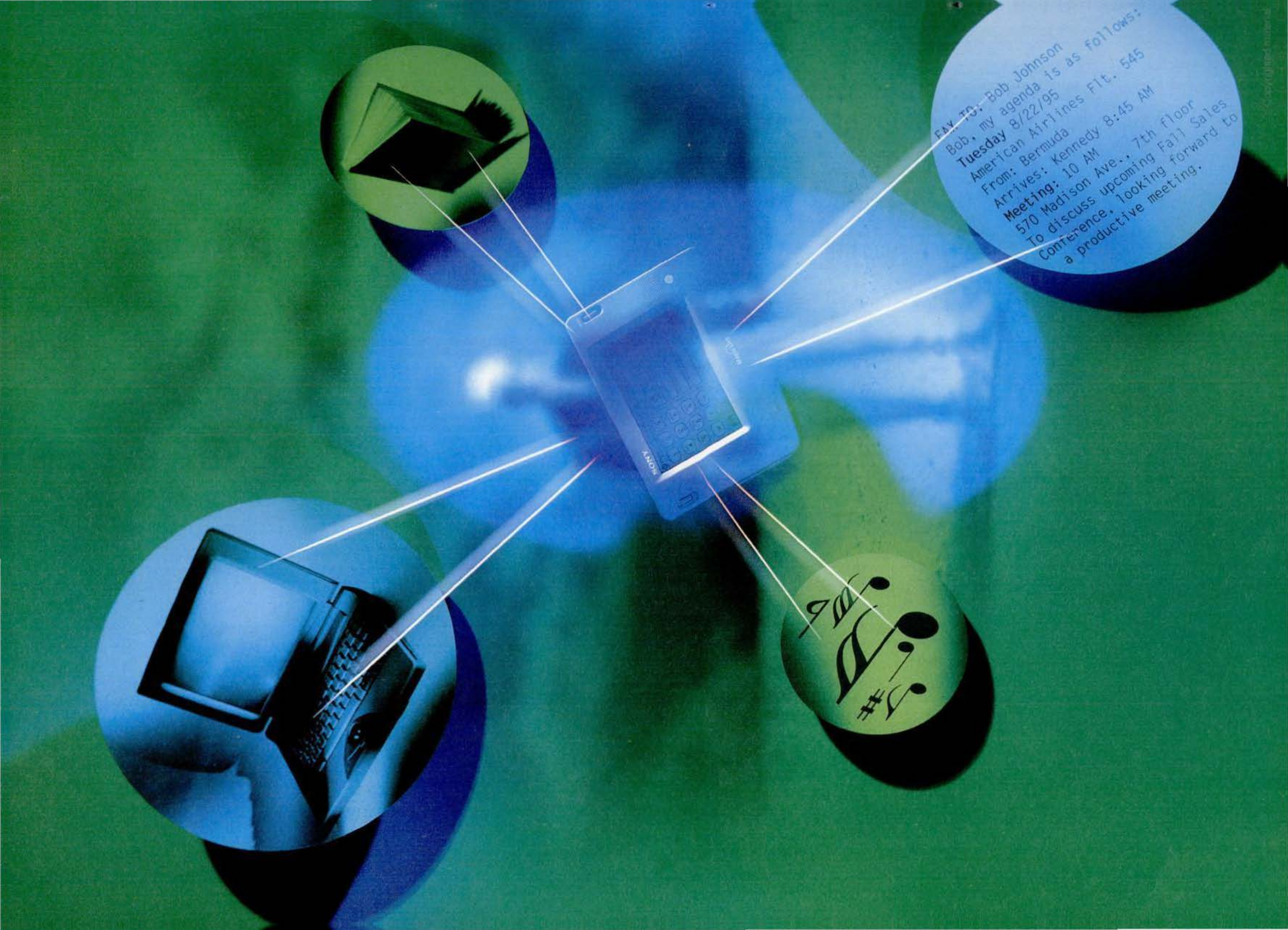
FAX TO: Bob Johnson
Bob, my agenda is as follows:
Tuesday 8/22/95
American Airlines Flt. 545
From: Bermuda
Arrives: Kennedy 8:45 AM
Meeting: 10 AM
570 Madison Ave., 7th floor
To discuss upcoming Fall Sales
Conference. looking forward to
a productive meeting.
SONY

THE WORLD

The information skyway is coming soon to a wireless device near you.

THEY SAY YOU NEVER FORGET your first wireless gadget. Well, OK, maybe they don't say that. Nonetheless, I remember mine well: a cheap transistor radio from Radio Shack that cost me a week's pay peddling the local newspaper. But it's not the radio itself I recall so fondly. It's the freedom that sawbuck bought me. From then on, the Rolling Stones toured with me. It was magic.

BY CHRIS O'MALLEY

PHOTOGRAPH BY GEOFF SPEAR • INFOGRAPHICS BY KARL GUDE

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The Little Pager that Grew Up

PERHAPS NOWHERE IS the potential of wireless communications more aptly illustrated than with the pager. Once simply a "beeper" worn by doctors, the lowly device has grown into a kind of message center for the 1990s. So-called alphanumeric pagers with small LCD screens can show not only a phone number, but a complete message as well—whether dictated to an operator or sent by a computer's modem. And many paging companies now offer the convenience of receiving e-mail messages on your pager. E-mail generally can be automatically forwarded from an online account or sent to you directly via an operator or a computer system using special software sold by paging companies.

Your pager can also let you know that you've received a fax or a voice mail message. SkyTel's SkyFax service, for example, beeps you when a fax is received through a special toll-free number. You can then call the SkyTel system to direct the fax to your office or hotel. PageNet offers a similar service called FaxNow. Voice mail options work in much the same manner. Pacific Bell's Message Center, for example, will page you whenever a new message is received in your voice mailbox.

But the best is yet to come, as paging finally becomes a two-way street. By the end of this year, with a bidirectional pager, you'll be able to acknowledge messages by choosing one of the 120 canned responses included in the unit's software. The first bidirectional pager to appear will likely be Motorola's Tango, a 5.6-ounce unit containing a flip-up panel that acts as an antenna for transmitting and receiving.

The Tango pager is expected to work first on a new two-way paging network developed by SkyTel, a division of Mtel. Mtel got an early start in the emerging "personal communications services" arena by being awarded a "Pioneer's Preference" license from the FCC in 1992. Most of the other big names in nationwide paging, including MobileComm and PageNet, purchased similar two-way licenses in the subsequent FCC auctions.—*Jeff Hecox*

It still is. At the moment, the magic is emanating from a modem the size of a credit card, tucked snugly inside my laptop computer, which sits on a shaded picnic table facing the Atlantic Ocean. A short, thin cable connects the modem to my cellular phone, itself a folding monument to miniaturization. The modem dials the cellphone, and within a matter of minutes I'm wirelessly transported to the Internet and the home page of who else but the Rolling Stones. Magic. Freedom.

That is, until the pager beeps, flashing an urgent electronic message across its matchbook-size screen: "Need diapers now."

Welcome to the wireless world. It's a world in which nearly anything we previously did with wires can be done without them. A world in which new ideas—many of them unthinkable with wires—seem as boundless as the air they travel through. And a world that audaciously promises not just a series of technological marvels, but a kind of lifestyle liberation. Unplugged, we have more choices about where we work, play, and live. Untethered, we can travel far and stay close at hand. Unhitched, we can blithely bypass the cable TV and phone company networks and tap into new streams of information and entertainment.

To an extent, it's a world we already know: More than half of all U.S. households own a cordless phone, for example, and 25 million people roam completely free, yakking on cellular phones. Yet in the long view, it's a world we can hardly conceive of: Our children may one day call their kids to supper with display-equipped kitchen appliances that use satellite signals to pinpoint their playground locations and place videophone calls to their wristbands.

In the interim, the rapidly evolving wireless world is poised to change our lives in less dramatic but significant ways, even over the latter half of this decade. While we await the paving of the information highway, consider how the wireless skyway is coming to your home, car, computer, and suit pocket:

- **The airwaves are ringing.** Long used primarily to make calls where a wired telephone wasn't convenient, cellular phones are now being recast as full-time, full-function phones. Basic services such as call forwarding and voice mail, coupled with the option of having one phone number wherever you go, are making it more practical to receive calls on your cellphone. Next up: cellular phones that automatically become cordless phones (transmitting to a wired base station) as you pull into your house's driveway.
- **Pagers are talking back.** Whether they're simple beepers or short-message display models, pagers have always shared a basic limitation: They receive, but they can't send. Now new paging networks being tested will let you answer from the hip. The first of these two-way pagers, including Motorola's Tango, will allow you to send acknowledgments, like "yes," "no," or "got it." The next wave will let you reply in longer verse.
- **Data is flying.** New error-cushioning cellular modems, such as the Toshiba Noteworthy model I hooked to my Motorola flip phone, enable you to send and receive computer data at reasonably high speeds over the turbulent airwaves of today's cellular network. A new digital network known as CDPD (cellular digital packet data) is being rolled out across

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the country this year and next. Meanwhile, the alternative radio-frequency data modems and networks are getting faster, smaller, and cheaper. Motorola's new Personal Messenger 100D fits on a PC Card, for example, and wireless e-mail service via the RadioMail service costs $39 a month.

• **Wireless is working.** Many people who formerly worked with clipboards are now getting their jobs done with electronic pads or tablets that can wirelessly send and receive information to and from other people and computers. And it's not just UPS drivers and supermarket stock clerks. At hospitals run by the Veterans Administration, doctors and nurses will soon record, process, and communicate patient information using electronic tablets from Telxon.

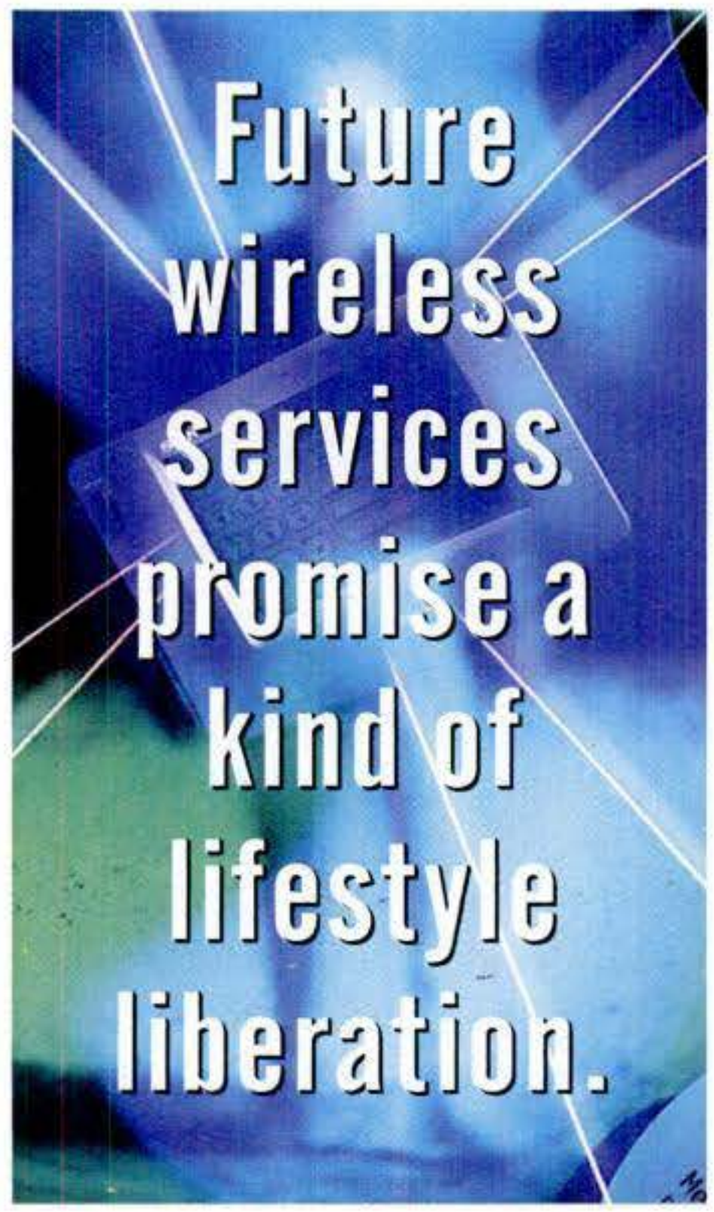
• **Daytimers are going digital.** The promise of "personal digital assistants" may finally be realized as new pocket computers add a missing ingredient to the mix: convenient wireless communications. New personal communication services (PCS) networks, such as Mtel's Nationwide Wireless Network debuting next year, put most of the sending and receiving power for e-mail and faxes in the network, so PDAs with wireless features can be smaller and lighter. And they'll be able to last weeks, not hours, on batteries.

• **London is calling.** And so, too, will Tokyo, Berlin, Moscow, and the rest of the world when new satellite phone networks begin providing round-the-globe service later on this decade. Today's cellular phones are generally useless outside their native soil—or once you're a few miles at sea or aloft in a plane. But with a phone that communicates with satellites ringing the planet, rather than with land-based antennas, you'll be able to call literally from anywhere to anywhere. Motorola's Iridium project, backed by international phone companies, will likely be the first such service. But other parties are interested. Among them are Microsoft's Bill Gates and McCaw Cellular's Craig McCaw, who've formed a satellite phone company called Teledesic to do the same.

• **Dishes are shrinking.** Satellite TV dishes are becoming smaller and more affordable. Led by Thomson's pizza-size RCA Digital Satellite System—and competitors like Sony—television may be going back to its wireless roots. In the process, the dishes are offering more channels (many of them dedicated to movies and sports) than cable TV, and superior video and audio quality. Eventually, they may offer data services for interactive TV and PC connections. More down-to-earth microwave TV systems are beginning to offer alternatives to cable, too.

• **Cars are riding on air.** The radio broadcasting data system (RBDS) is expected to routinely—and wirelessly, of course—send news headlines, traffic reports, weather advisories, and information about the music being played to millions of display car radios within the next few years. Radio-based "intelligent" highways and car navigation equipment guided by Global Positioning System (GPS) satellites will be able to show you alternate routes when the going gets slow.

• **The gadgets are coming!** Cordless phones and TV remotes were just the beginning. Among the multitude of new wireless items that could catch on are personal GPS compasses, pager pens and watches, cordless infrared printers, and pocket communicators for kids—the latter already the rage among girls in Japan.



Lest we forget amidst the airborne commotion, the trend to wireless is truly a worldwide phenomenon. Millions in China are using pagers to communicate in places where no wired telephone network exists. Millions more in African countries are sidestepping their backward infrastructures with cellular phones. Satellite TV service is a staple of daily life in many European nations.

What all of these wireless technologies have in common—and the fount of their tremendous potential—is the part we can't see: the transfer of information over thin air. Magic is not a bad word for it. It's the combined sorcery of electrical and magnetic forces, or electromagnetic waves, regenerating each other at incredibly high speeds (roughly 300 million meters per second, or about three quarters of the way to the moon with every tick of your watch).

Scientifically, it all gets started pretty simply. Change the motion of an electric charge—push it, wiggle it, vibrate it—and you've produced an invisible but measurable and controllable wave of energy that can be used to carry a human voice, a computer file, or a left-turn command for a radio-controlled car. The key is how often the charge gets manipulated. That determines the number of wave cycles per second, or the frequency, and in turn the distance between the waves, or the wavelength. Imagine a long, taut rope being moved up and down briskly at one end, and you've got a good picture of how these waves behave.

Electromagnetic waves go through us, bounce off us, and zip past us all the time, usually without harm or even notice. Visible light occupies only a tiny sliver of the electromagnetic spectrum, wedged between infrared and ultraviolet frequencies.

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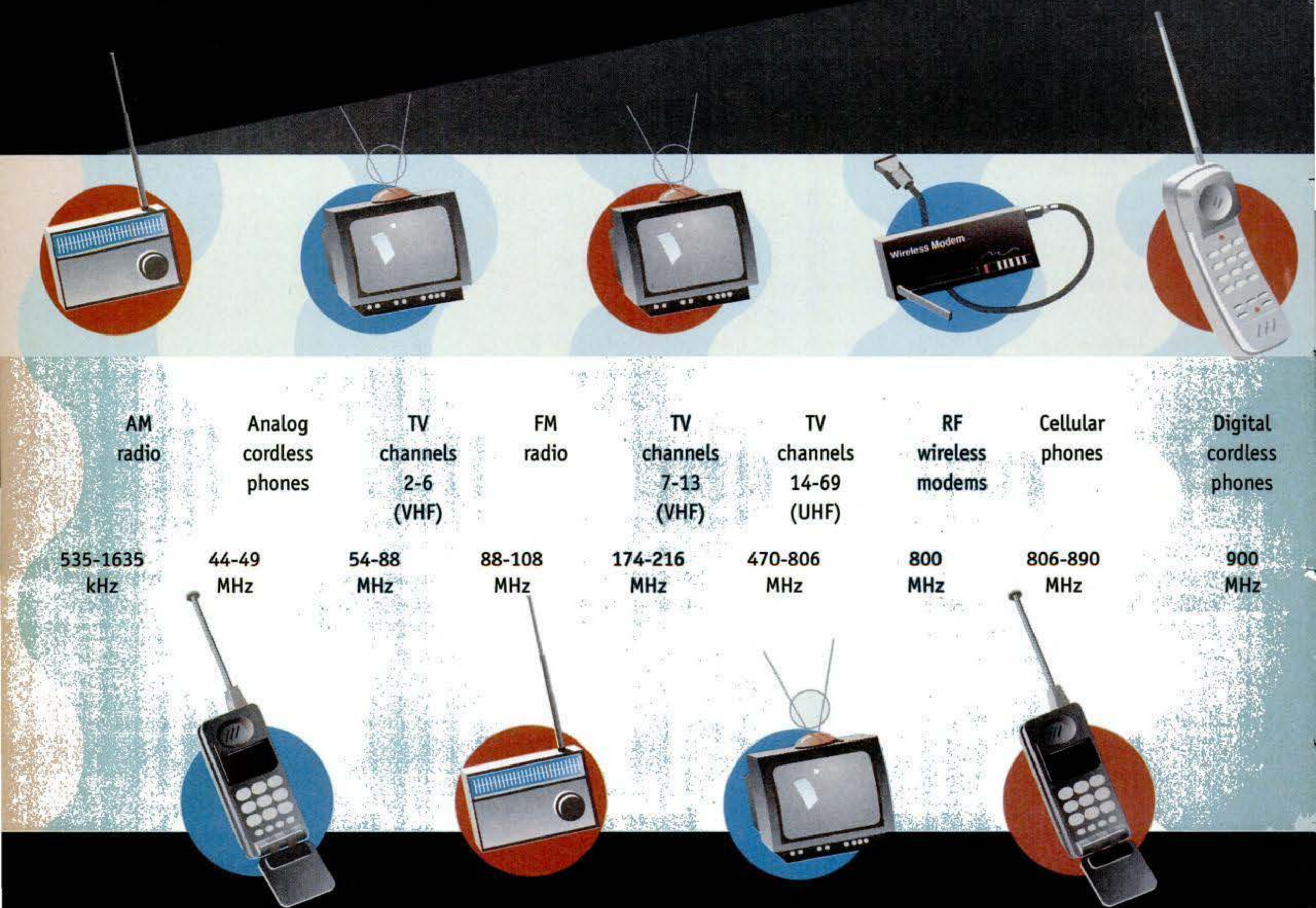
The Radio Spectrum

Most of the wireless devices we use operate within a portion of the electromagnetic spectrum known as the radio spectrum, a range of wavelength frequencies between 3,000 cycles per second (three kilohertz, or 3kHz) and 300,000,000,000 cycles per second (300 gigahertz, or 300GHz). Below the radio spectrum are very low frequencies, such as those emitted by power and telephone lines. Above the radio spectrum are the frequencies representing infrared, visible, and ultra-violet light, as well as X-ray, gamma-ray, and cosmic-ray frequencies.
Here are where some of the more common wireless devices fit into the radio spectrum:



(Not coincidentally, our eyes are visually tuned into the wavelengths most efficiently radiated by the sun.) And it's only at levels above visible light, including UV rays, X rays, and gamma rays, that electromagnetic waves are known to be harmful (though some people contend they've been damaged with lower frequencies, by using a cellular phone or living near electrical power lines or microwave transmitters.).

The waves generated by today's electronic gear are typically produced and interpreted by semiconductors, or chips, using the broad areas of the spectrum known as radio waves and microwaves. Radios, TVs, and older communication and navigation systems have used these waves for years, first with electronic vacuum tubes and then microchips.

There is, however, a limited amount of "space" within the radio and microwave range, and wireless devices must operate on different frequencies in order to work without interfering with each other. So new wireless gadgets and services must compete for increasingly narrow

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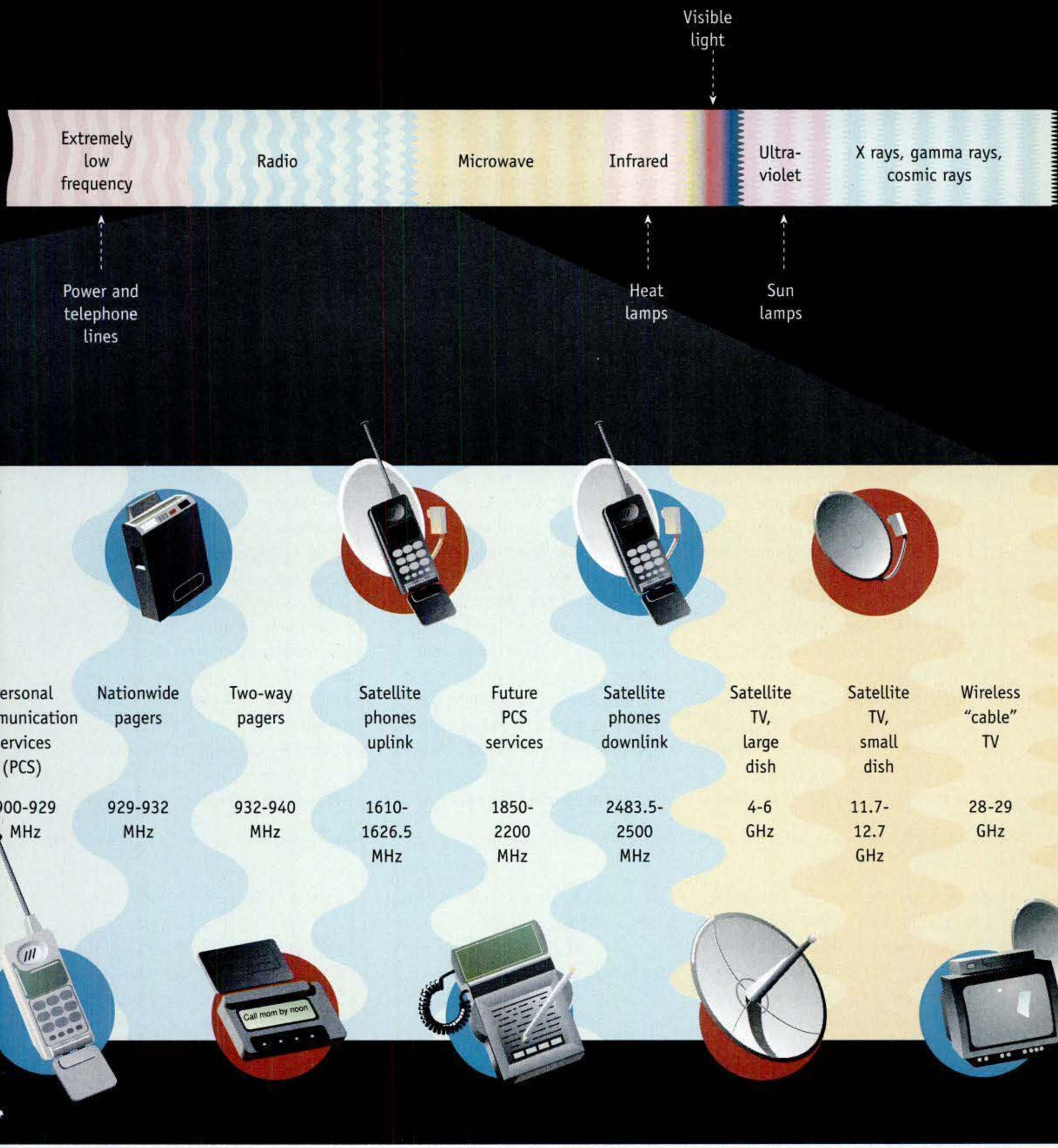

bands of unused or reassigned space. And the keen interest in new wireless technologies has led to a kind of modern-day gold rush for more portions of the radio spectrum.

In the United States, it's the Federal Communications Commission that classifies and hands out licenses to use parts of the radio spectrum. Or at least the FCC used to hand them out. Currently, the FCC is auctioning off some of the spectrum to the highest bidders, at billion-dollar prices that can make downtown apartments in Tokyo seem like bargain basements. Indeed, it's a telling commentary on what lies ahead when the most precious "real estate" on the planet isn't even on terra firma.

But while we can't grow more of this ethereal spectrum, we can use what we've got more efficiently—and, in effect, clear new avenues for wireless communication and widen others. One way is to free up, or "reallocate" in FCC parlance, portions of the radio spectrum assigned to the U.S. government or older communication systems such as those for commercial fleets and railroads. Another, more promis-

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A Home with Frequency Overload Doesn't Seem so Sweet

THINK OF ALL the devices in your home that rely on wireless links—cordless phones, baby monitors, radios, and wireless speakers, for starters. As the number of devices that rely on wireless transmissions increases, however, so does the potential for interference.

Interference occurs when a signal traveling at a specific frequency meets up with another traveling at that same frequency. Each signal has an amplitude (strength) and phase (its point on an s-shaped sine curve), and when these two both meet, they combine to form a new signal; in the extreme, they can cancel each other out. Usually you simply receive a degraded signal, often experienced as irritating static.

The FCC assigns frequencies to specific devices and determines the distance over which they can broadcast data. For instance, the transistors inside television sets operate at a frequency of about 44MHz. They will affect other devices operating at 44MHz only if they're within a few feet of the TV, however. Radio stations, on the other hand, which also broadcast over specific frequencies, can cover an area of many miles.

Adding an additional wireless device to your home isn't as easy as finding a free outlet. You need to consider the disruptive effect it might have. A couple of things to consider: Baby monitors, many cordless phones, and the transistors inside your TV all operate within the same frequency bands. Most phones can operate at several frequencies, so your interference problems are usually solved easily by manually or automatically seeking a free channel. If that doesn't work and you have one of the new 25-channel phones, try moving the phone's base station farther from the TV.

The other class of devices, including wireless speakers, digital cordless phones, remote control extenders, and microphones for use with camcorders, operates in the low 900MHz range. According to the FCC, speakers and telephones do not share the same precise frequencies, so you should be able to tune your speakers to an available frequency. Also, since 900MHz phones operate over a broader range of frequencies, they should automatically be able to seek out a free channel.

In an unscientific experiment, POPULAR SCIENCE set out to see how many 900MHz devices could be operated in a New York City apartment at once without significant interference. Unfortunately, we stopped at one. After tuning 900MHz wireless speakers from Recoton to all available frequencies, we were unable to get a Cobra 900MHz digital spread-spectrum phone to produce even a weak dial tone. Only when all wireless speaker components had been powered down would the phone work.

The phone company says it's a problem with the speakers. The speaker company says it's a problem with the phone. The FCC says it's not supposed to happen. The moral of this tale: Look before you leap into the wireless world. And save your receipts.
—*Suzanne Kantra Kirschner*

ing way is to have the airwaves carry digital rather than analog signals.

Why go digital in the air? Mainly, because any collection of digital signals—whether it's a computer file or a voice call that's been converted from analog sound waves into bits—can be compressed into a small fraction of its original size before being sent over a radio frequency. The difference can be dramatic. In many cases, digital compression techniques make it possible to send only one bit of data for every 25 to 100 in the original digital form. That effectively increases the capacity of the radio channel by a factor of 25 to 100 times.

It's already happening with cellular phones. Cellular service providers across the country are rushing to upgrade their network equipment to handle digital calls, and in many cases subsidizing the cost of digital-ready cellphones (hence, the many one-cent and one-dollar phones out there). While all of this is costing the companies money now, it will alleviate the capacity problems that keep some calls from going through at peak-demand periods. And it will give the companies room to grow, and presumably room to cut prices as more people buy cellular phones and service.

Surfing the airwaves is not without its own perils, however. Floating phone calls through the air, for example, has proven too tempting for many thieves and pirates. Cellular carriers say the illegal use of their networks costs them about $500 million per year. And it can cost you some privacy, too. Eavesdropping on cellular phone calls is still alarmingly easy for anyone with the inclination and the proper radio scanner. Data may prove just as vulnerable, though digital encryption techniques are expected to make wireless transmissions more secure.

Right now, pushing data through the air also limits the speed at which information can be moved. While the best wireless modems are now consistently attaining respectable speeds (9,600 bits per second and up), for example, they're certainly no match for moving computer data over wired local area and global networks. Data deliveries by satellite might be, though.

These and other clouds will make the ride bumpy at times, but they won't likely change our course. We're flying warp speed into the wireless world of ubiquitous communications. ◆

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#1 in Tires

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Lean, Mean, and Green

A low-cost, high-tech approach to safety and lower emissions. By Dan McCosh

HONDA THUMBS ITS NOSE at the overachievers in Stuttgart and Tokyo by introducing an all-new Civic for 1996 that is something of a technological watershed, a low-cost platform that makes quantum-leap improvements in fuel efficiency, emissions, and crashworthiness.

The seriousness of Honda's effort is underscored by the introduction of a continuously variable transmission (CVT). It will be offered as an option in the United States on the Civic HX Coupe. The other models in the Civic lineup—a hatchback and a sedan—have a more conventional four-speed automatic as an option.

The CVT eliminates the gear-ratio steps inherent in conventional transmissions by using a steel belt between two pullies that vary in diameter, seamlessly presenting an infinite number of gear ratios. Honda is not the first with a CVT; that honor goes to Volvo, which was followed by Subaru with the Justy.

CIVIC HX VITAL STATISTICS

Engine	16-valve SOHC 4-cylinder	**Suspension**	4 wheel double wishbone
Displacement	1.6 liters	**EPA Mileage**	38/45 mpg (manual) 35/41 mpg (CVT)
Horsepower	115 @ 6,300 rpm	**Price**	$12,500 with CVT
Transmission	5-speed manual (standard), CVT (optional)		

But the introduction of this technology to a car line as pervasive as the Civic—10 million Civics have been sold since it was introduced in 1972—could well be the step that finally brings the CVT into the automotive mainstream.

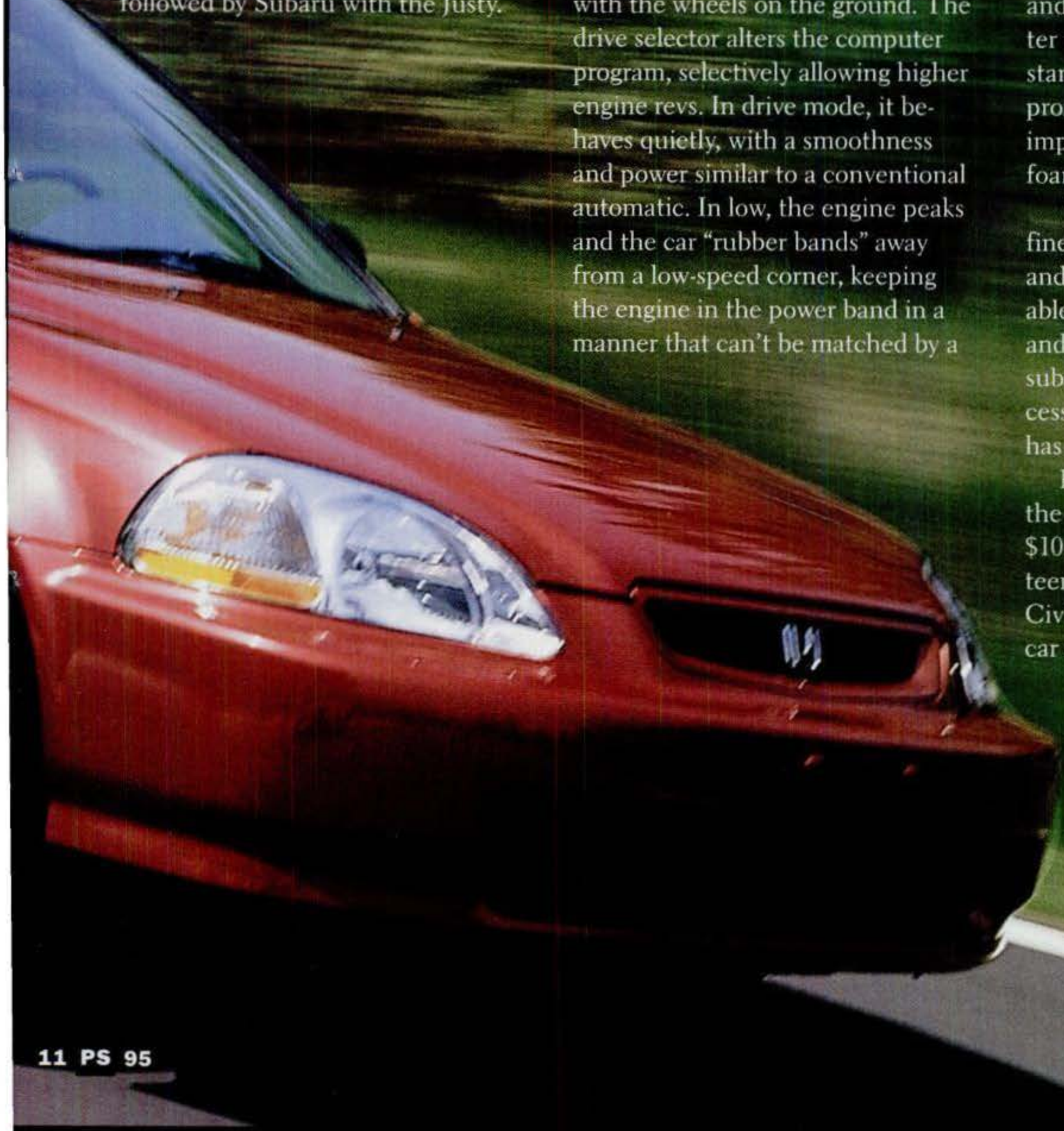
The 115-horsepower engine in the Civic HX raises the presumed horsepower limits of the CVT, which has been restricted to vehicles with relatively low power. Honda redesigned the belt to accomplish this feat and uses a multi-plate clutch at the output side of the belt drive to disengage the unit when stopped. This allows towing the car with the wheels on the ground. The drive selector alters the computer program, selectively allowing higher engine revs. In drive mode, it behaves quietly, with a smoothness and power similar to a conventional automatic. In low, the engine peaks and the car "rubber bands" away from a low-speed corner, keeping the engine in the power band in a manner that can't be matched by a manual or conventional automatic. With the new lean-burn VTEC-E engine coupled to the CVT, Honda claims up to 25 percent improvement in real-world mileage over conventional automatics.

The new 1.6-liter base engine meets the California low-emission vehicle (LEV) standard, several years before the requirement goes into effect. Honda engineers met the standard by reworking the combustion and locating the catalyst directly in the exhaust manifold, where it lights off quickly at start-up.

The new Civic chassis is designed to withstand both side impact and offset frontal crashes. The latter test is not required by federal standards but probably better approximates real-world crashes. Side impact is handled with crush-zone foam pads.

The Civic's dynamics have been fine-tuned for a more supple ride and improved steering. More noticeable is the effort to lessen engine and road noise: The new Civic is substantially quieter than its predecessor. It is a few inches longer and has more head- and legroom.

Pricing is expected to be close to the current Civic, starting under $10,000 and climbing up to the mid-teens. That could well establish the Civic as the lowest-cost high-tech car on sale today.



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Canon's new Eye Controlled Focus is operated by the movement of your eye.

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But there's more to the ES5000 than just what meets the eye. Consider its many other sophisticated features. Like a powerful 20x Optical/40x Digital Zoom, Canon's renowned Optical Image Stabilization system, a Super-High Resolution 180,000-pixel Color Viewfinder, and a high-quality Hi8 format for truly professional results. Add to all that its sleek, ergonomic, metallic design and you begin to see why the super-compact ES5000 is the biggest news in camcorders today.

For more information on the ES5000, simply call us at 1-800-OK-CANON. We're sure you'll find it to be an eye-opening experience.

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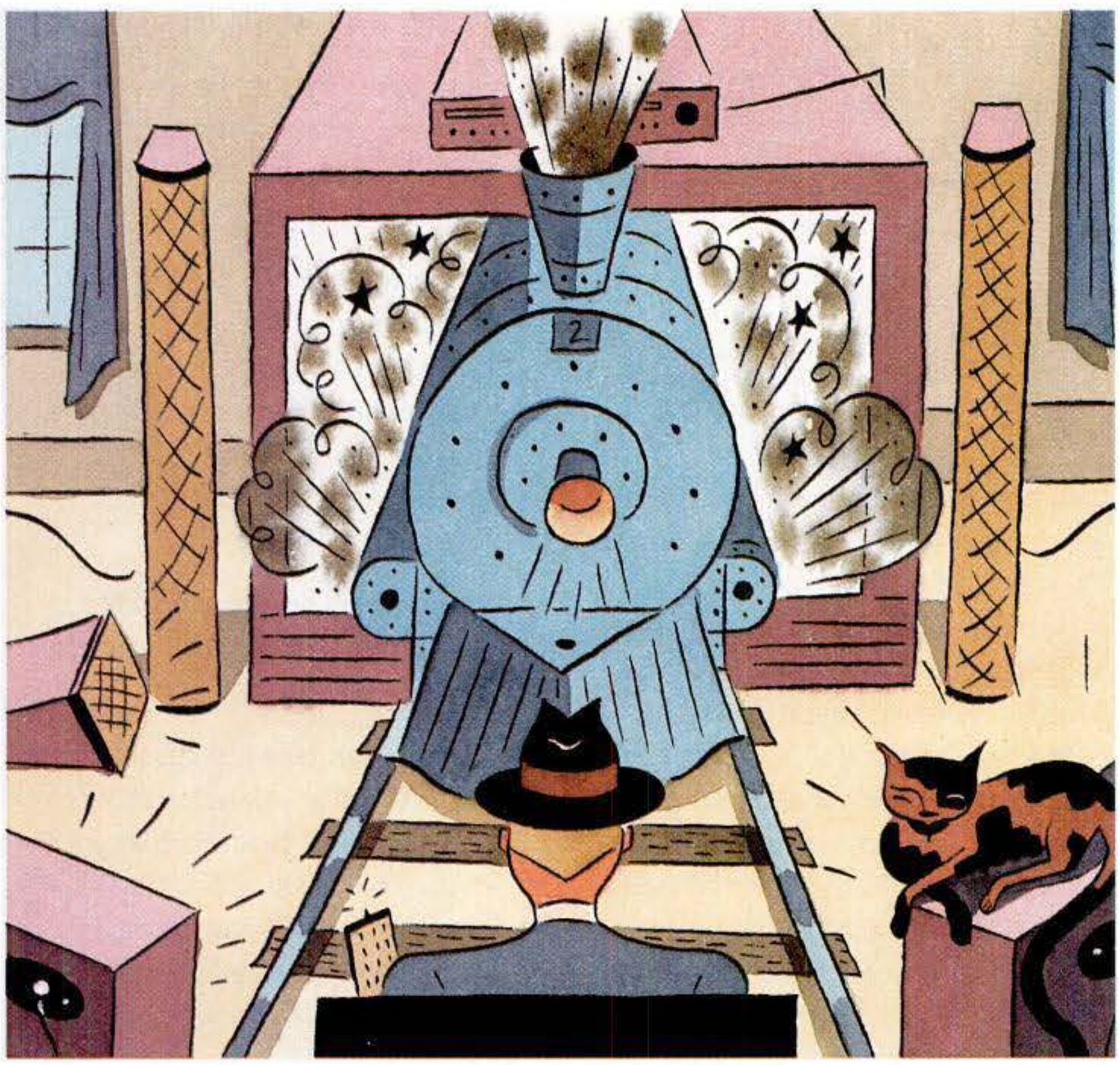
ESSENTIAL TECHNOLOGY GUIDE

TELEVISION

As we hurtle toward a digital-everything future, the reality is that television is society's dominant and most pervasive electronic technology. However, the basic box wrought in the 1920's is an ever-changing technological pallette of new content and capabilities. Go on, be a couch potato. Just be sure you do it in high-tech style. BY MICHAEL ANTONOFF

MICHAEL KLEIN



Everything You Need to Know About Descramblers

IT IS NOT ILLEGAL to sell, buy, or own descrambler boxes. But if you use one, you're responsible for paying for the subscription programming you receive. If you don't, you risk prosecution for theft of services. Descrambler proponents argue that a consumer has a right to own rather than rent his own equipment. Kind of like a telephone. If you do buy a descrambler, however, you run the risk of it not working if your cable company changes its technology.

You Know It's Home Theater If...

...IT'S THE BEST thing you've ever heard on your television. The sound of a speeding train in *The Fugitive* pans from left to right and your eyes and ears are synched to the moving image. On an NFL broadcast, fans cheer from behind you, commentators quip directly in front. Sure, a home theater has got to have a big screen: 27 inches or larger. But it's the high fidelity VCR or laser disc player, an audio-video receiver with Dolby Pro Logic surround-sound decoder feeding external speakers front, rear, and center, that transforms your bedroom into the Bijou.

To build a home theater, you can spend wretchedly excessive dollars and hours connecting audio components of unending sophistication. Or you can do something smart and simple: Hook up a so-called home theater in a box to your large-screen TV. Sony, Magnavox, Bose, 3M, Pioneer, and others make these surround-sound audio systems. If you absolutely want the cutting edge in home theaters, however, go digital. Dolby's Surround AC-3 provides discrete left and right rear channels and a dedicated subwoofer channel in addition to left, center, and right front channels. Some recent laser disc releases such as *True Lies*, *Forrest Gump*, *Interview with a Vampire*, and *Stargate* include AC-3 soundtracks. They are compatible with several new laser disc players from Pioneer, Mitsubishi, Runco, and Theta and receivers from Audio Design Associates and Yamaha.

So now that you know everything—please pass along the buttered popcorn and hush up.

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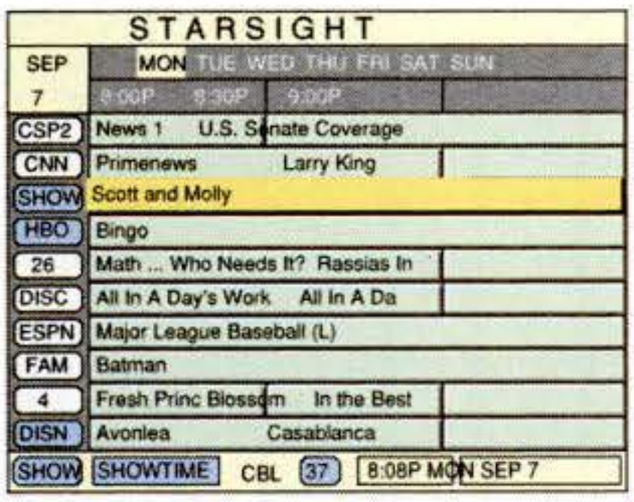
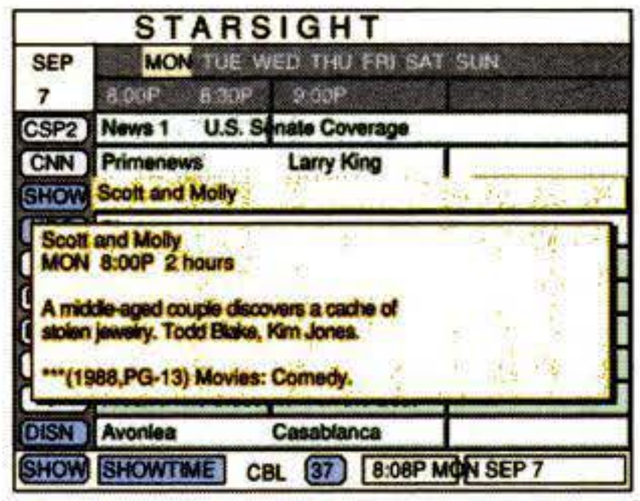
Point & Press Program Guides



Schedule guide



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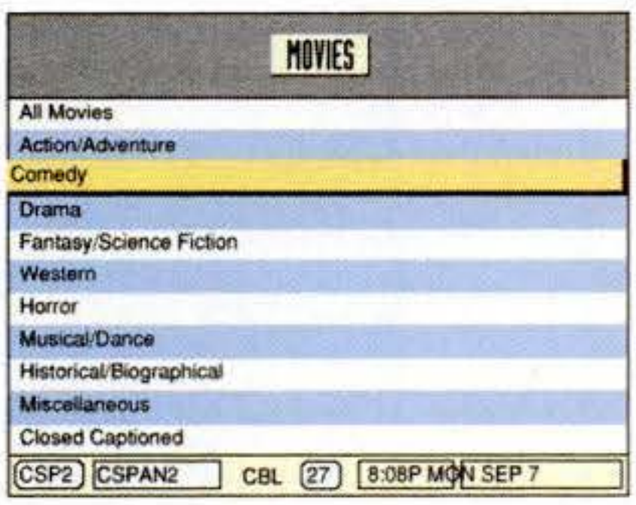

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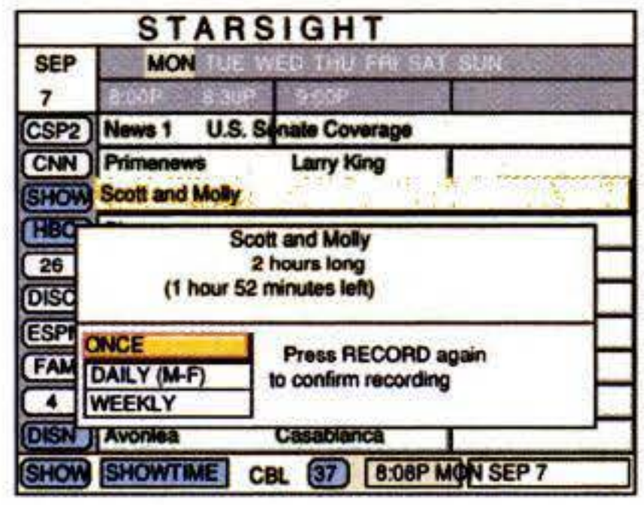

Program to record

FOR MANAGING your TV time, paper is passe. The high tech here and now is an interactive guide that's displayed exactly where you need it most—on your TV screen.

The channel surfers' choice is a service called Starsight from Starsight Telecast in Fremont, California. You get the title of the show at the bottom of your screen (even during commercials), a display of time remaining and, with the press of a button, a plot summary or list of stars. Starsight gives you a video version of the full program grid; you can browse through listings and synopses of other shows without leaving the channel you're watching, or find a list of programs by theme. Made your choice? Press the Enter button and Starsight switches the channel. Starsight is seven days' worth of data—updated daily—encoded in your PBS station's signal; it's delivered via cable or over the air to a decoder device. Starsight-equipped TV sets are available from Zenith and Mitsubishi; Samsung and Goldstar offer the capability in VCRs. Magnavox makes a $150 add-on Starsight accessory. Subscriptions run about $4 a month.

Need more convincing? How about an end to VCR programming hassles? Press one button; it's done.

Other guides will be coming soon. Videoguide will use the BellSouth MobileComm paging network to broadcast listings, for $40 per year, to an add-on decoder box (about $100). Gemstar Development plans to embed its Guide Plus data in the ABC Television broadcast signal for free, though you'll need a specially equipped VCR to use the information.

Solving the Cable Box Conundrum

USING A CABLE BOX might prevent you from taping one show while watching another. You can rely on your cable company for help—but that may involve additional equipment and fees. Other solutions exist, but if you have a TV with dual tuners (better sets with picture-in-picture capability have these), you might try this:

Step one: Screw an inexpensive two-way signal-splitter onto the end of the coaxial cable before it connects to any equipment.

Step two: From the splitter, run one short length of coax to the cable box and another separate connection to the second antenna input on your TV set. (Splitters and cable are available at your local electronics store.)

Step three: Connect your cable box to your VCR and then connect your VCR to your TV.

Now you can tape any channel on your VCR while you watch other non-scrambled channels that your cable company provides. (Premium channels like HBO can be viewed only through the cable box.)

Where Does the V-Chip Stand?

THE HOUSE AND SENATE have fallen in love with a concept called the V-Chip that would enable parents to block violent or sexually explicit programs from their TVs. A provision requiring TV manufacturers to include the still-nonexistent V-chip in new sets was approved as part of extensive efforts to change the nation's telecommunications laws. For this to happen, broadcasters would have to establish ratings, similar to what moviemakers do; the code would then be embedded in the program signal. Here's who favors (✔) the V-chip, opposes it (✘), or overwhelmingly supports it (✔✔).

Congress: ✔✔ **President Clinton:** ✔ **Broadcasters:** ✘

Set manufacturers: ✘ **Civil liberties groups:** ✘

Chip makers: ✔ **The public:** ✔✔

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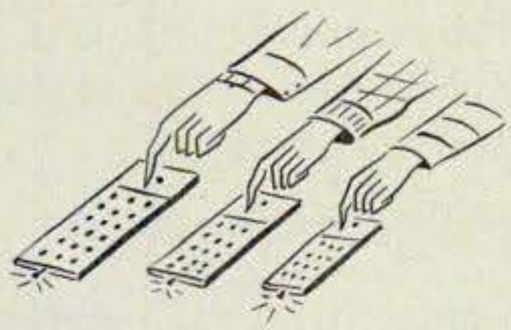
MICHAEL KLEIN

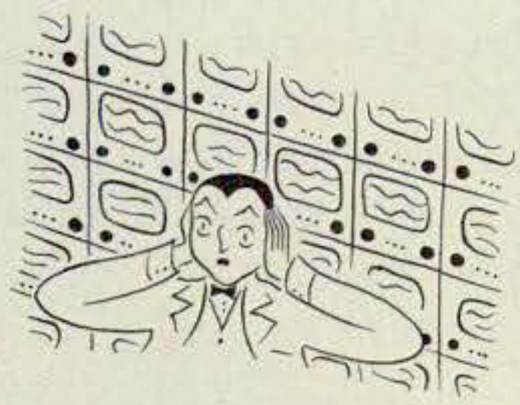
If Enough is Good, Too Much is Better

MOST OF US—67 percent—prefer to rent a movie for home viewing rather than go to a theater.

LARGE SCREEN TVs (27 inches and larger, direct view, and projection) are selling at a rate 12 percent higher than last year.



MEMBERS OF the average American household watch more than six hours of television per day. But fully 40 percent of consumers say that they are dissatisfied with what's on.

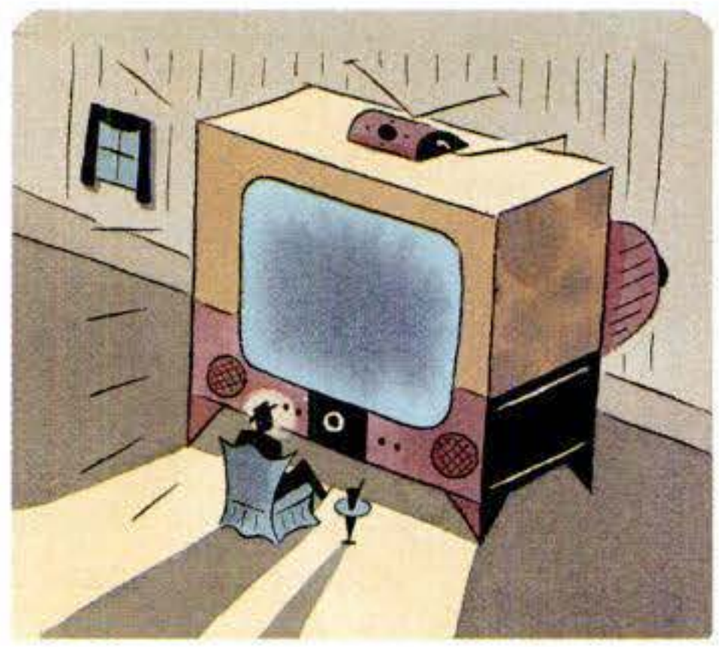


THE AVERAGE cable-TV household receives 50 channels. If you're counting, that equals 16,800 half-hour program segments per week.

THE SOLITARY boob tube is an endangered species: 93 percent of TV owners have something—a VCR, cable TV, a video game system—attached.

Sources: Times Mirror Center for the People & the Press, 1994; Electronic Industries Association, 1995

MICHAEL KLEIN



The Big Picture

ALL JUMBO SCREENS are not technologically equal. Your choices are:

1. DIRECT VIEW is the basic cathode ray tube technology on steroids. An engorged 40-inch screen is the largest one made by Mitsubishi. The CRT is the recommended choice for the brightest picture and widest viewing angle. But you'll pay the price in heft and huge cabinet depth—well beyond what most standard entertainment units typically accommodate. Price: from less than $1,000 to $4,000 for sets 27 inches and up.

2. REAR PROJECTION aims red, green, and blue picture beams so that they converge on the backside of a screen inside a cabinet. Large screen size—from 40 to 80 inches—at relatively low weight and cabinet depth are the attractions here. What you sacrifice is some of the picture brightness and the widest possible viewing angle. Price: from $2,000 to $8,500.

3. LIQUID CRYSTAL DISPLAY projection utilizes the latest technology: active matrix panels similar to notebook computer displays. Light passing through the LCDs creates the image, which is focused on a wall or screen across the room. There's great flexibility here: The projector can be moved, mounted, or hidden. You can build it into a coffee table or suspend it from the ceiling. As with a slide projector, images from an LCD projector can be sized up or down. Want a 200-inch picture? No problem if you've got a room big enough. One caveat: There's an inherent tradeoff between picture size and brightness. And a further warning: Viewing an LCD screen in a brightly lit room is an exercise in futility. Price: $2,500 to $10,000.

TV Sets that Do the Job

For the Kitchen:

RCA's KitchenVision is a 13-inch TV/VCR combo ($549) with washable remote, a must when following cooking tapes that require chicken fat.

For on the Go:
The TV-on-a-rope is Sony's FDL-22 Watchman with Straptenna and 2.2-inch LCD screen. It weighs 10 ounces ($160), and it won't fall off your neck when you get up to cheer at a game.

For the Living Room:

The 32-inch Sony Trinitron XBR KV-32XBR45 is a direct-view TV with top-mounted operating panel and rounded top that together make a stylistic stand against even the possibility of set-top clutter.

For the Home/Office:
Packard-Bell's Corner Computer includes a base that turns the 20-inch screen into a TV (prices ranging from $1,399 to $2,999 depending on PC options) and includes a remote controller that can be used for the TV or as a wireless mouse.

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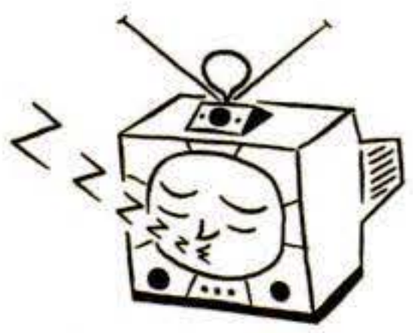
Tuned In

TV FEATURES WE LOVE

- Self-adjusting sound even when the commercial comes on. (Magnavox)
- Self-setting date/clock. (Televisions from Mitsubishi; VCRs from Sony and Samsung)
- Multiple still picture-in-picture-size windows that update themselves every few seconds to show at a glance what's playing on other channels. (Hitachi and others)
- Self-adjusting picture brightness according to the amount of light in the room. (Sony)

Tuned Out

TV FEATURES WE THINK ARE SILLY



- For viewers who have presumably fallen asleep, sets whose timed-turn-off function shows sheep leaping across the screen. (RCA Thomson)
- Ability to leave messages for another family member on the TV set instead of on the fridge. (JVC)
- Ability to dress up—with a mustache and glasses, for example—face icons that can be clicked on to list channel and movie-rating preferences. (RCA's DSS)
- Starsight-equipped TVs with only 256K causing you to commit data triage, while still requiring the same subscription price as those with 512K. (Early model Zeniths)

MICHAEL KLEIN

All Remotes Aren't Created Equal

USER-FRIENDLY FEATURES:

- Big buttons with numbers in graphic relief or functions with unique shapes so that you can feel them in the dark.
- A mode indicator for universal-type remotes so you know, for example, *before* pressing the volume button that the active infrared code is set for the TV—not the VCR.
- A swap, or flashback, button to let you toggle between two channels. (On universal remotes, this function can at least be added to a programmable button.)

USER-HOSTILE FEATURES:

- Hard-to-read labels using lilliputian text or dark lettering on a black background.
- Important functions (such as the 0-to-9 keypad for nonconsecutive channel switching or TV/VCR display toggle) hidden behind a cover meant to "simplify" the remote.
- Covers that are difficult to open.
- Channel switching that takes two seconds or more to complete because your remote's instructions are passed along by yet another infrared device affixed to a set-top box.

Why You Need an Earth Dish

TINY (18-INCH) dish antennas that receive digital television from satellites display a picture that is way sharper than conventional broadcasting or cable. Our experience puts the Digital Satellite System (DSS) from RCA on a par with or better than laser disc, and the CD-like sound is superb. New developments with little-dish TV antennas enable you to get an interactive program guide and set ratings limits.

Depending on the program packages selected, subscribers have more choices (including audio music channels) than cable customers.

At an electronics store, you can buy an RCA or Sony dish, set-top receiver, and installation for less than $1,000. Through your cable company, you can rent the 39-inch Primestar dish, starting at about $8 per month.

Satellite systems don't supply local channels. So you'll need an A/B switch to tune these in from a connection cable or over the air.

Whatever happened to those huge 10-foot satellite dish antennas? They're very much alive and well and worth your attention for something little-dish antennas can't provide: the behind-the-scenes news feeds and syndicated programs that networks are distributing around the country prior to airtime.

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Worker ants spend their entire lives bringing home sustenance to the queen and her young.

(We apologize if this sounds familiar.)

Work, work, work. And what do you have to show for it? We'd like to suggest the most thrilling home entertainment experience ever. A Pioneer® Dolby® Surround AC-3™ Audio/Video Receiver and LaserDisc Player. The first in the industry, our VSX-D3S receiver with

advanced AC-3 technology gives you the distinct pleasure of hearing six independent digital channels for true surround sound. Plus, all the power you demand from an advanced home theater system. The result? With our AC-3 receivers and AC-3 compatible LaserDisc players, your home theater can deliver

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The Wing Flies Again

An exquisitely restored 1940s Northrop flying wing is back in the air. It still looks like the shape of tomorrow. By Stuart F. Brown

The view from the pilot's seat: A classic, sky-blue 1940s Northrop logo graces the N9M-B's cockpit.

ABOUT 24 hours of flight time and 35 takeoffs and landings are in the log book, and the members of the Northrop N9M-B test crew are beginning to feel they understand their airplane's flying qualities. Chief pilot Don Lykins is putting the finishing touches on the official flight manual, and two other pilots have already been checked out in the bright yellow-and-blue craft.

This is the second rigorous flight-test program for the N9M-B. Why do things twice? To stay safe. The original testing took place in 1945, and those records are long lost. That was the year a team of engineers and craftsmen working under the leadership of aeronautical wizard Jack Northrop completed fabrication of the single-seat, all-wing plane—mostly from wood.

With World War II raging, aluminum was reserved for the fighters and bombers being cranked out by the thousands and sent into combat. Even the owner of Northrop Aircraft could scrounge only enough of the lightweight metal to fabricate the center section of his radical no-tail, no-fuselage, all-wing experimental aircraft.

For the past 12 years, a crew of volunteer fabricators and technicians has stolen Saturdays and other bits of free time to meet in a musty factory in the industrial sprawl of Los Angeles. There, under the tireless leadership of Ron Hackworth—who oversees maintenance and modern-

PHOTOGRAPHED BY FRANK B. MORMILLO

JOHN B. CARNETT

Rebuilding the Wing

N9M-B restoration volunteers work on the flying wing. The skin surfaces and intricate internal structures are mostly made of wood. Decayed wooden components (lower left) were replaced by hundreds of newly fabricated pieces.

ization of McDonnell Douglas jetliners for a living—the volunteers resurrected the historic flying wing.

All sorts of people chipped in over the years, many of them affiliated with Southern California's aerospace industry. Rockwell engineer Keith Parker and his wife meticulously reworked the plane's hydraulic flight controls, which his father had originally designed and built. One restorer wasn't an airplane guy at all, but a weekend woodworker whose usual specialty was furniture. His expertise was essential to reviving lost wooden-aircraft fabricating methods.

The wing's power is provided by a pair of horizontally opposed, eight-cylinder Franklin "pancake" engines, which aren't easy to maintain. Only nine of these experimental powerplants were built by the long-defunct manufacturer. Luckily, someone tracked down a former Franklin technician, who dusted off his notebooks and helped sort out oil-leak glitches afflicting the oddball engines. Now they run reliably.

On visits to the workshop over the past three years, I watched the complex internal structures of the wooden outer-wing sections take shape. It was almost sad to see the wing skins finally applied and painted, because they hid the beautiful work within. Made from strong and expensive many-layered German plywood, the myriad pieces of the wing's skeleton were cut and fitted as finely as the body of a violin or an elite wooden racing sailboat.

For years, the N9M-B's neglected remains sat under the scorching Mojave Desert sun in an obscure corner of Edwards Air Force Base, looking like a formless pile of junk. Then Edward Maloney, founder of the Planes of Fame air museum in Chino, California, rescued them.

The plane was from a flock of four small experimental flying wings Northrop built and flew. Thirty years later, these flying wings influenced the design of the big, batlike B-2 stealth bombers seen traversing the same skies today. One of the wings crashed during a 1940s test flight; another is in the aircraft collection of the Smithsonian Institution in Washington, D.C.

Witnessing the restored N9M-B's second flight last November at Chino Airport was inspiring yet worrisome. After about 40 minutes of gentle maneuvers and flybys above a large and enchanted crowd, pilot Lykins radioed back something about mechanical problems and prepared for landing. As the wing touched down, observers were alarmed to see that neither of its pusher propellers was spinning. He was making a dead-stick landing.

"I was having trouble with the hydraulic governor," Lykins recalls, "which got the propeller blades stuck at an angle that made the engines almost useless, so I shut them down." A retired Delta Airlines captain with experience in dozens of different aircraft, Lykins collaborated

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with experts at the Air Force Flight Test School at Edwards to develop a cautious and methodical flight-test schedule to rediscover the N9M-B's character.

"Before the first flight," he says, "we had calculated what I could safely do to get back down on the ground if anything went wrong. So when the problems happened, I had already gone over and over the possibilities with some magnificent aeronautical minds, and I had a Plan B and a Plan C to fall back on."

The Northrop flying wings were the product of Jack Northrop's fascination with the "span loader" concept [see "Megaplanes," April '95]. This design philosophy calls for an all-wing structure that provides both aerodynamic lift and packaging for the payload, spread over a large area. Northrop felt that such a plane would be lighter, smaller, and cheaper to build than a conventional wing-and-fuselage aircraft.

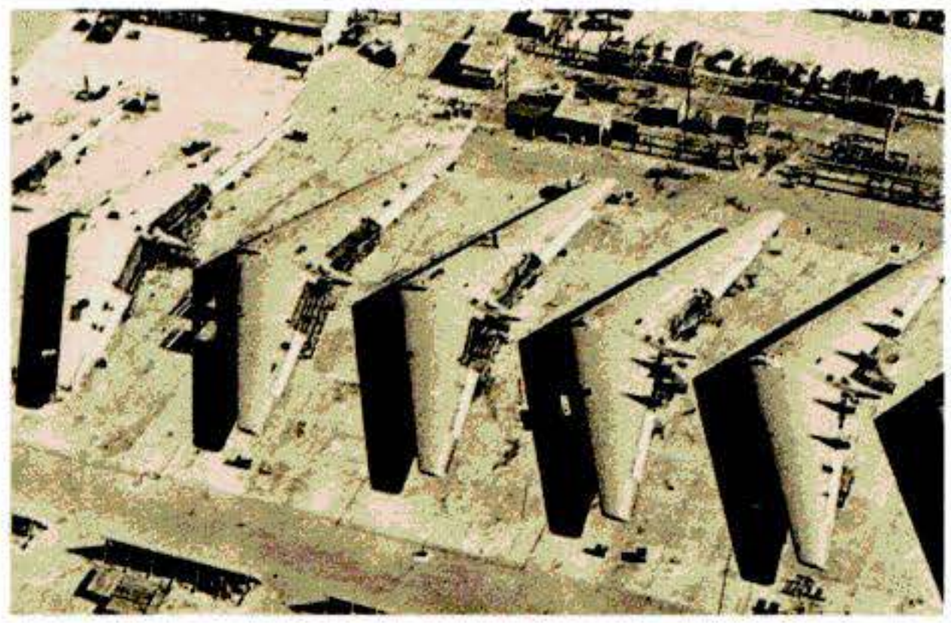
William Sears, professor emeritus of aeronautics at the University of Arizona in Tucson, was chief of aerodynamics and flight tests at Northrop Aircraft in the 1940s. The 60-foot wingspan N9M series were his and Jack Northrop's birds. They designed the single-seat planes for one purpose: cheaply and quickly simulating, at one-third scale, the flight behavior of a 180-foot-span experimental flying-wing bomber called the XB-35, which the military had commissioned Northrop to build. Sears calls this scale-model predictive method and the math equations that accompany it "dynamic similitude."

Restoration team leader Hackworth has now made a flight in the wing, as has another seasoned aviator with unique qualifications: Bruce Hinds, who was chief Northrop test pilot on the B-2 stealth bomber program for 9 years and made the first flight of that big, black flying wing. Hinds offers his impressions of the two flying wings conceived three decades apart: "These are forgiving airplanes, and it's the large wing area that does it," he observes. "They have a lot of lift, so a small pitch-up adjustment is all it takes to get airborne during takeoff. The big difference between the two airplanes, of course, is that the B-2 is computer-controlled, which gives it excellent directional stability. In the N9M-B, you have to make little yaw corrections to keep the nose pointed where you want it."

Flight tests back in the mid-40s were more casual, aerodynamicist Sears recalls. "Johnny Meyers, our chief test pilot, wanted me to go along on some of the N9-M flights. There was no room, so they made a little sideways chair for me to sit on with my knees to one side, and the back of Johnny's neck in my face.

"Coming back to land one day, we realized that the left main landing gear was stuck in the up position. Johnny wasn't worried. He descended so expertly that the plane was down to about 25 mph before the left wingtip scraped on the runway. We made a gentle spin and stopped right in front of Jack Northrop, who said, 'Bill, you really shouldn't be in there.' He was such a gentleman. I said, 'Jack, I'm only trying to do my job.'" ◆

Northrop's Giant Wing



B-49 flying-wing bombers lined up at the Northrop Hawthorne, California, plant in 1948. Politics have since doomed the 13 Northrop wings to the scrap heap.

WHERE ARE NORTHROP'S B-49 flying wings today? Nowhere to be found. Even a grand tour of the world's great aircraft museums wouldn't yield a peek at one of the most interesting and imaginative flying machines ever built. All of them were melted down for scrap in an act of destruction that took laborers wielding axes and cutting torches three months to complete.

During World War II, Army Air Corps planners began to worry that if England fell to Hitler, long-range heavy bombers could be needed to attack Germany nonstop from bases on America's East Coast. Their optimistic goal was to develop a bomber capable of carrying 10,000 pounds of bombs 10,000 miles.

The promised efficiencies of Jack Northrop's flying wing attracted government funding. So did the B-36, a huge six-propeller conventional bomber conceived by Northrop's archrival, Consolidated Aircraft, in Fort Worth, Texas. Designer Northrop and aerodynamicist William Sears launched the 180-foot-span XB-35 prototype off the drawing board and into the sky with a quartet of pusher propellers powered by big radial-piston engines buried inside the thick wing-fuselage. All of the predictions about how the XB-35 would behave in flight had come from testing the one-third-scale N9Ms.

By the war's end, Northrop had installed eight compact turbojet engines in a version of the big wing called the B-49. Although the military initially ordered 30 reconnaissance models of the B-49, it later decided more speed was needed than the thick-winged plane could efficiently deliver.

Strategic Air Command founder General Curtis Lemay preferred the B-36, with its range of 9,000 miles carrying 10,000 pounds of bombs. The B-36 eventually sprouted four added-on turbojet engines, and served as the Air Force's long-range heavy bomber until the all-jet B-52 was introduced. Air Force Secretary Stuart Symington cancelled the B-49 flying wing program in 1949.—*S.F.B.*

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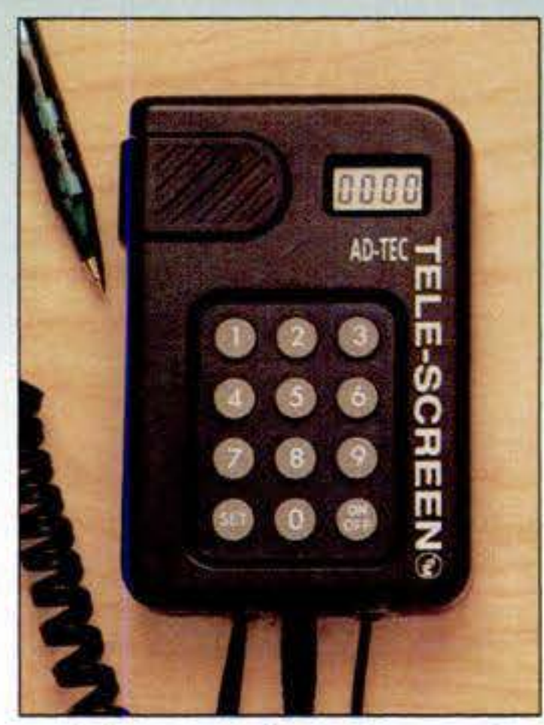
WELCOME TO THE EDGE



Take back control of your telephone.

Tele-Screen™ Phone Protector eliminates unwanted calls. Harassing calls, sales calls, any call you wish. Incoming calls are greeted by a voice prompt: *"Thank you for calling. Please enter the four-digit pass-code."* Your phone rings only if the caller enters the correct code. Voice prompt repeats and if no code is entered, the caller is automatically disconnected! Use the keypad to change the code, or de-activate the unit. It's like having an unlisted phone number when *you* want it unlisted. Like during study, meal-time, romantic evenings, or when you only want calls from those you gave your password to. Also secures fax and modem lines!

- **Tele-Screen™ #TS-300 $44.95**

Installs easier than an answering machine, with its own AC power pack. Rings once to let you know it's working. Un-Telescreened extensions will regular ring.

Own a piece of history from the cold war.

From Red October to the brutal battlefields of Afghanistan, the all steel "Commanderski" watch was a badge of honor. Emblazoned on its white Russian face is the hammer, sickle, and red-star of the USSR's glory days. CCCP is highlighted below. Made in the original factory outside Moscow, before the break-up. Now yours. Adjustable steel band. 17 jewels. Shock, dust, and water-proof. Accurate to seconds per month. Own the last of a genuine cold-war treasure. Get yours and get to your next party meeting on time, comrade.

- **Rare! Soviet "Commanderski" Officers Watch #RW-05 $39.95**
- **Two for $69.90, save $10.00**

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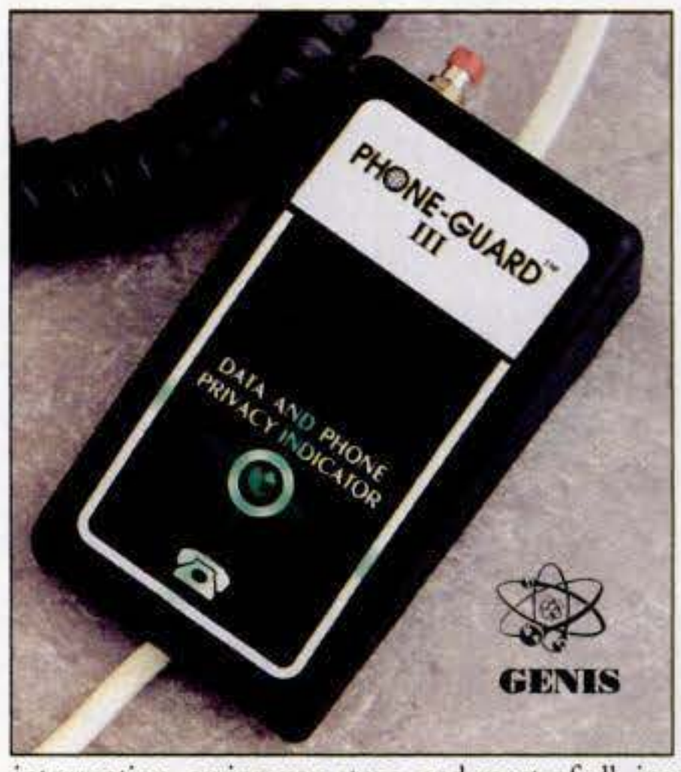
Straight from the year 2368 AD. Command your TV with the next generation in universal remotes.

Set your Phaser to TV, VCR, or even cable. Press a button. With Star Trek sound effects, you change channels, volume, mute or power up. As you key in each command, the Phaser fires with a deep ruby glow. Now go where no remote has gone before. From the on-going mission, direct to you. App. 9". Compatible with all major components and brands. Want to try one risk-free? Call now and make it so.

- **Star-Trek Next Generation, Type II Phaser Remote #2378 $39.95**



New Phone-Guard III keeps your calls private. And more.

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Run any tool or appliance from your car, truck, boat, or camper. Full 100V AC power from your vehicle's 12V battery. A miracle of modern technology – in a 5" x 4" package. It works by duplicating the complex "sine-wave" of AC power. Now you can recharge power tools on the job, watch TV while camping, access your laptop PC, or just plug in a lamp and read under the stars. Completely safe for both your car and your appliances. Even when the car is off. Automatic alarms won't let you drain the vehicle's battery, or overload your appliances. Now enjoy all the convenience of real power-to-go.

- **PC140 Power Invertor,** single receptacle, delivers 140 watts continuouspower, 200 watts peak power. **#PC-140 $49.95**
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New electronic Bodyguard™ uses touch-technology. Scares the bejeezus out of intruders.

Hang one inside your door. The tiny red LED lets you know it's armed. Before an intruder even turns your doorknob, Bodyguard rips out a *staggering* siren, alerting you and sending thugs scurrying for easier pickings. Bodyguard also protects file cabinets, desks, pool gates, or your car. Outside, take it hiking, jogging, or on your next errand. In the event of trouble, click a switch and the siren *shrieks*. A ruby-strobe provides even more protection. Or switch it to red-lens flashlight for key locating, car map-reading, or starlit strolls. Measures 5" x 2 1/2" x 3/4", and requires just one 9v battery. The Bodyguard. Get two – one for home or travel, and one for someone you care about.

■ **Electronic Bodyguard Portable Alarm System #DA-36 $19.95**

GRIP. CUT. SAW. PRY. FIX. OPEN.

Stop lugging around your heavy tool box. With one tool you can now: loosen and tighten bolts. Fix a leaky faucet. Cut rope, wire, or wood. Tie a fly. Clean a trout. Pry open a paint can. Tighten a bike cable. Adjust a friend's carburetor. Or just kick back and slice an orange for your kids.

Unlike plastic handle imitations, Plus-Pliers 100% steel construction wipes clean after each use. Slotted handle gives you a tough grip – under the sink or in the rain. Best of all, it closes down to just 5 1/2 inches, so you can take it anywhere. Includes belt holster. Slip it over your car visor, and be prepared on the road, too. Lifetime warranty.

■ **All Steel Pliers-Plus Tool #GRP-69 $29.95**
Just $24.95 each when you buy two! Save $10.00!

"Truth is, I just don't much need to drag around my old rusty tool box anymore."
*– **Fireball Smith,** Vermont handyman*

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Take on saber-tooths, wooly mammoths, and your next chores, too.

Discover the knife your ancestors used in the last ice age. Some things just can't be improved. 30,000 years ago, the clan leader who created such wondrous tools was master of his world. Today, on Oregon's Great Basin each is painstakingly flaked from pure translucent obsidian – the volcanic glass forged in the very furnaces of the earth itself. Sharp enough to shave a buffalo, each is sinew-wrapped to genuine crown stag antler. The result? Nine inches of unsurpassed beauty, history, and power. On your loin-cloth, under glass, or skinning your next task, behold the knife that survived evolution itself.

Our obsidian factory, c.10,000,000 B.C.

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Designed for the KGB. All metal micro-binoculars fold away to disappear into palm or shirt pocket. Yet super advanced coatings and huge 2.5 x 17.5 power yields crystal clarity, even in low-light conditions. Hunting, sports events, concerts, nature study, or surveillance. Now get the powerful 1 1/2" long cold-war edge.

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Honey, I Shrunk the Mice!

A newly discovered hormone drastically reduces the weight of obese mice in weeks. It may hold hope for the nation's legion of frantic dieters.

By Arthur Fisher

WHAT'S THE MOST widespread disease in the United States? Obesity. Fifty million Americans suffer from the condition, meaning their body weight is more than 20 percent higher than the ideal weight for their height. Obesity is also a major risk factor for a bevy of cripplers and killers such as diabetes, cardiovascular disease, stroke, some cancers, and some types of arthritis.

Most obese people struggle to shed fat through diet and exercise, often undergoing the tortures of the damned; their rate of success is dauntingly low. Many waste their money on weight-loss scams promoted by hucksters and snake-oil salesmen.

Is there something special about the metabolism of overweight people that defeats their best-intentioned efforts at fat reduction? Physiologists have long thought so. Now dramatic evidence indicates that chemically reversing a genetic defect can quickly turn a fat individual into a thin one—in laboratory mice, at least.

Dr. Jeffrey Friedman and colleagues at Rockefeller University and the Howard Hughes Medical Institute recently demonstrated that they can cut the weight of obese mice—which are three times heavier than normal mice—by 30 percent in just two weeks of daily injections with a hormone called leptin. Friedman says experimental results suggest that leptin regulates weight by controlling the amount of fat stored in the body.

Leptin is found in both mouse and human blood, but in tiny, almost undetectable, quantities. Its production is governed by a gene called *ob*, for obese. When this gene is defective, as in the fat mice—and, presumably, in some fat humans as well—not enough leptin is produced to control fat storage in the body.

When rotund rodents with a mutated *ob* gene are injected with leptin, the previously sluggish overeaters consume less food and burn more calories. And the weight loss comes almost entirely from stored fat. Amazingly, even normal, lean mice lose about 12 percent of their weight—almost all of it fat—with leptin injections.

The Rockefeller researchers have managed to manufacture leptin in the laboratory by cloning the *ob* gene, which they discovered earlier this year. The scientists insert copies of the gene into bacterial "factories" that then churn out the hormone.

REMI BENALI/GAMMA LIAISON

A TALE OF TWO MICE: Both of these rodents have a mutated obesity gene. The defect normally causes major fat gain, as in the mouse on the right, which weighs about three times as much as it should. The mouse on the left was once equally chubby, but after several weeks of injections with the hormone leptin it lost more than 30 percent of its fat. The treated mouse ate less and expended more energy than its companion.

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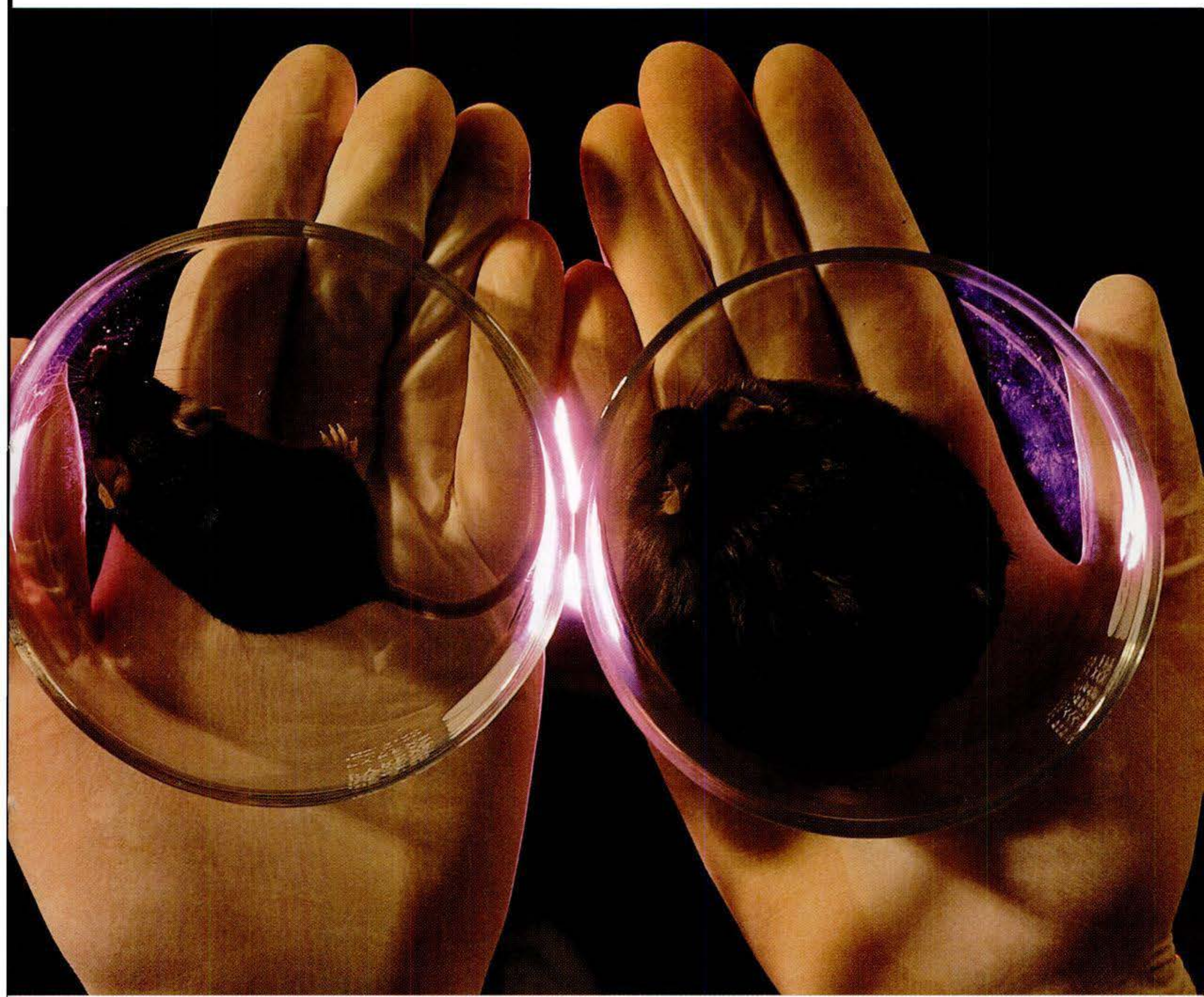

Although the *ob* gene was not isolated until recently, the first mouse with a genetic mutation causing obesity was found and studied by researchers at the Jackson Laboratory in Bar Harbor, Maine, in the early 1960s. In a stunning experiment there, Dr. Douglas Coleman patched together the circulatory systems of an obese mouse and a normal mouse. The obese mouse immediately began to shed fat—the first clue that an unknown substance in the blood helps regulate weight.

If human trials with leptin begin next year as planned, it will be at least five years before an anti-fat drug comes to market. But there is no assurance that it will cure all, or even most, cases of obesity.

There are at least five genes involved in mouse obesity, including "tubby" and "fat," biologist Juergen Naggert of Jackson Lab reported at a meeting there last July. And in another development last August, researchers said they had found the first human gene linked to adult onset diabetes, which is closely associated with obesity.

"The genetics of obesity are not so simple," Naggert says. "So far, everything we've learned about it has been surprising." ◆

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PS FEEDBACK

Dear Reader, we know you're interested in new products and technologies. We want your help to make POPULAR SCIENCE a magazine that is in step with your interests. Please fill out this questionnaire and mail it to **PSFeedback, 2 Park Ave., New York, NY 10016. Or fax it to us at 212-481-8062.** Or fill it out online at **http://www.enews.com/magazines/popsci** In future issues, we'll share the results of the Reader Poll. Thanks!

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☐ every month
☐ 6 - 12 times a year
☐ 1 - 6 times a year
☐ never

2. How much do you read of What's New?

☐ all ☐ most ☐ half
☐ some ☐ none

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1 2 3 4 5

I like the brevity of the items
1 2 3 4 5

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Do you think the federal government should reinstate funding to continue the search for intelligent life elsewhere in the universe?

☐ Yes ☐ No ☐ Not sure

9. How often would you like to see such a magazine run?

☐ every month
☐ 6 times a year
☐ 4 times a year

10. Are you a male or a female?

☐ male ☐ female

11. What is your age?

☐ Under 18 ☐ 40 - 49 ☐ 70 or over
☐ 18 - 29 ☐ 50 - 59
☐ 30 - 39 ☐ 60 - 69

12. What is your marital status?

☐ Single (never married) ☐ Married
☐ Separated or divorced ☐ Widowed

13. What is the highest level you completed in school?

☐ Some high school or less
☐ Graduated high school
☐ Attended college 1 to 3 years
☐ Graduated 4-year college
☐ Master's degree
☐ Doctoral degree
☐ Post doctoral degree

14. What is your total household income?

☐ Less than $15,000
☐ $15,000 to $29,999
☐ $30,000 to $44,999
☐ $45,000 to $59,999
☐ $60,000 to $74,999
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15. What is the Zip code of the area in which you live?

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FYI

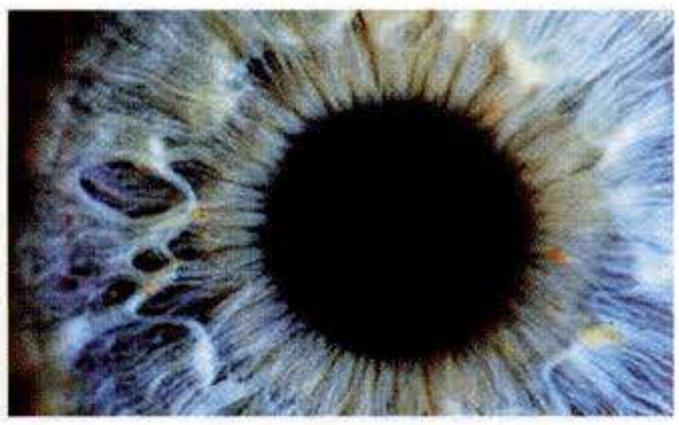
EDITED BY CECILIA WESSNER

THE FACTS

"The many different resolutions [of computer screens] measured in pixels have caused me to wonder how they compare with the resolution [in pixels] of the human eye."

Savraj Singh Dhanjal
Mercerville, New Jersey

MARTIN DOHRN/PHOTO RESEARCHERS



The human eye: not exactly like a monitor.

ONE CAN'T draw such a comparison, because a computer screen emits light, while our eyes have sensors that absorb light. An appropriate comparison, says Jeff Pelz, professor at the Rochester Institute of Technology, would be between a human eye and a camera.

"A typical amateur electronic [digital] camera has about 300,000 sensors," explains Pelz, "and the best on the market is a camera with about six million." A human eye has more than 100 million sensors.

However, that doesn't paint the whole picture, Pelz says, because these sensors are not evenly dispersed on the back of our eye; most are packed into a small area in the center. Because our eyes can move three or four times each second, he estimates that these sensors serve as the equivalent of nearly half a billion sensors.

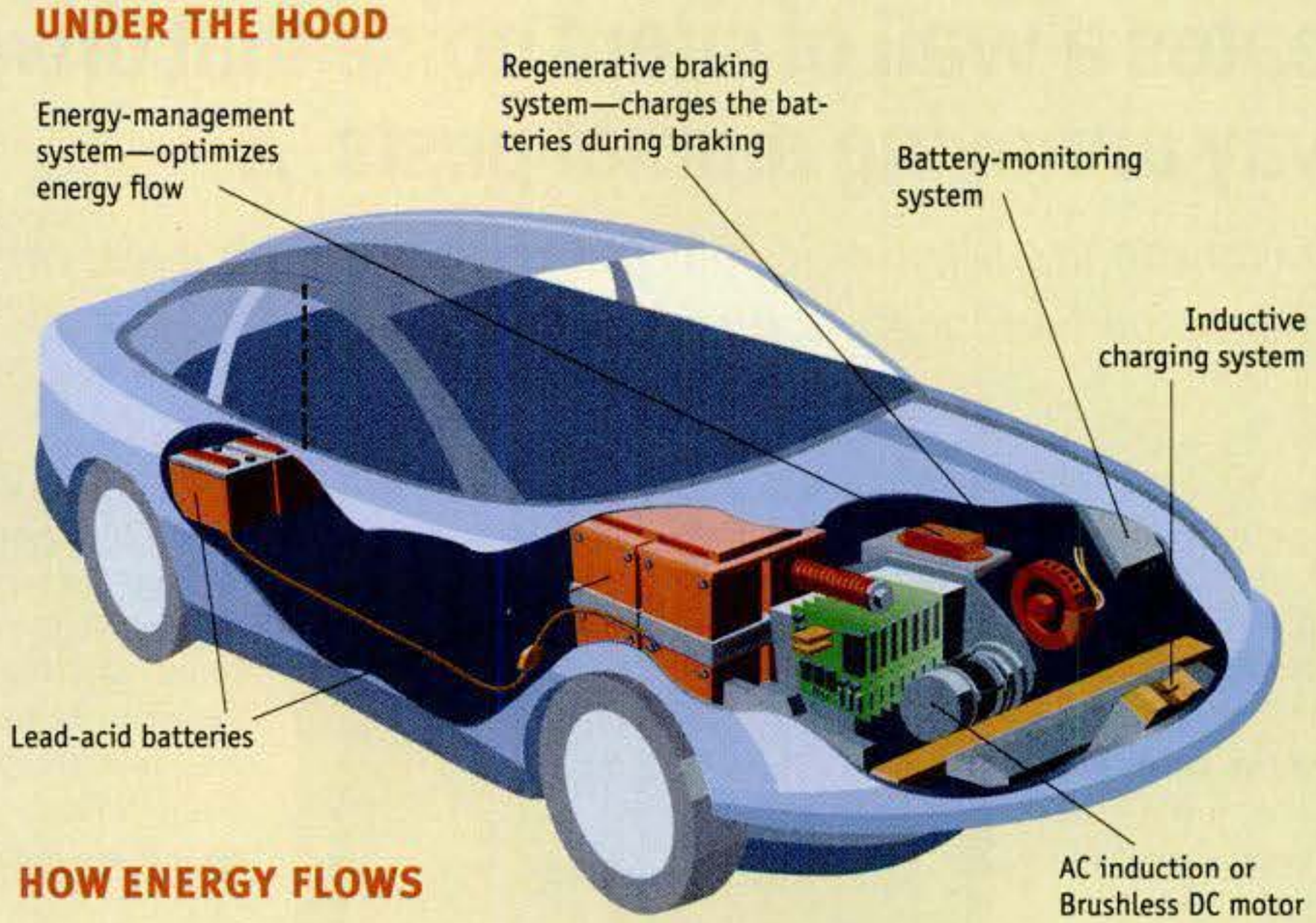
ANDY CHRISTIE

HOW IT WORKS

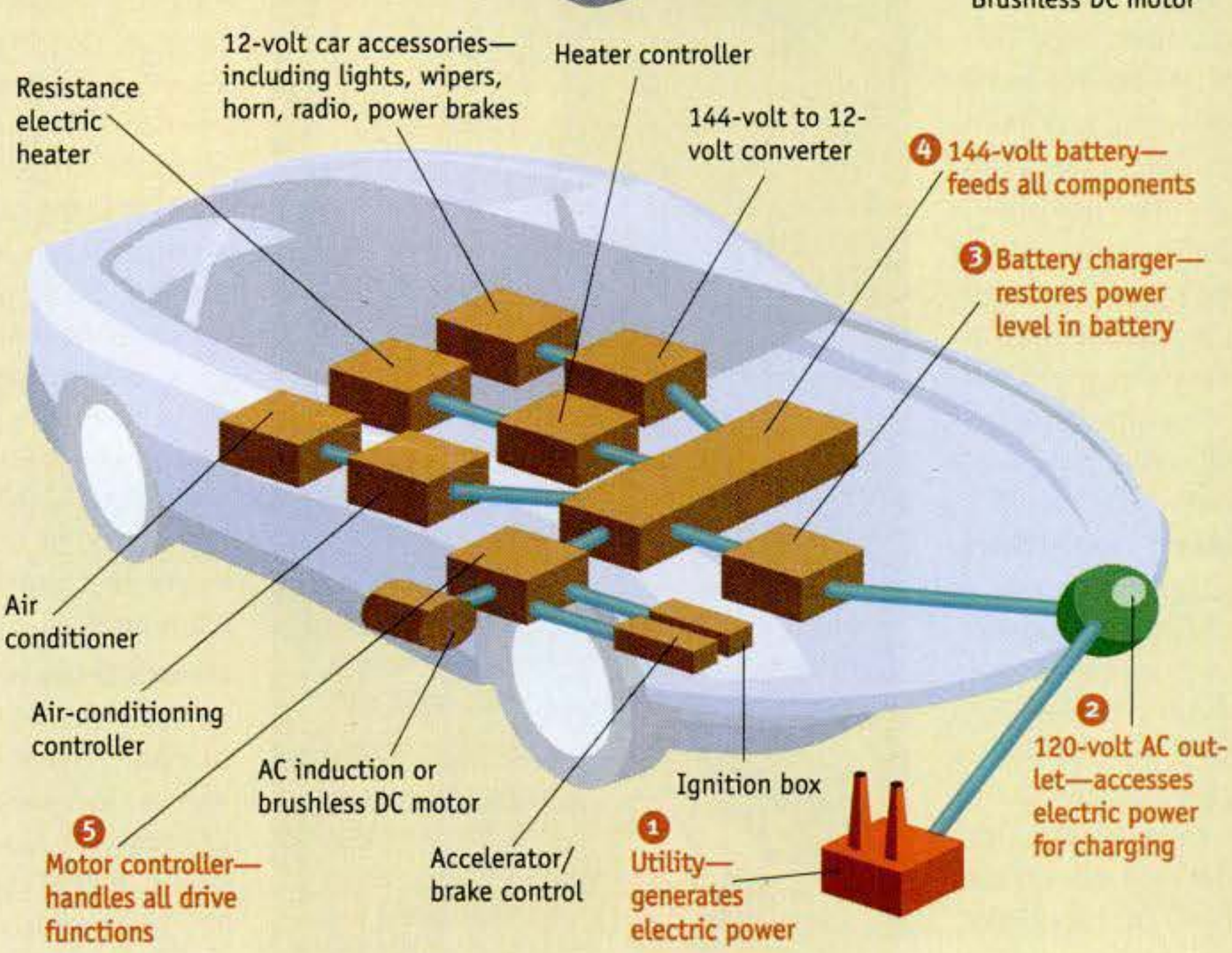
The Electric Car

IF YOUR ROUND-TRIP totals approximately 50 miles or less, you may be able to commute in an electric vehicle soon. Here's how your future to-the-office and around-town EV will work.—*Suzanne Kantra Kirschner*

UNDER THE HOOD



HOW ENERGY FLOWS



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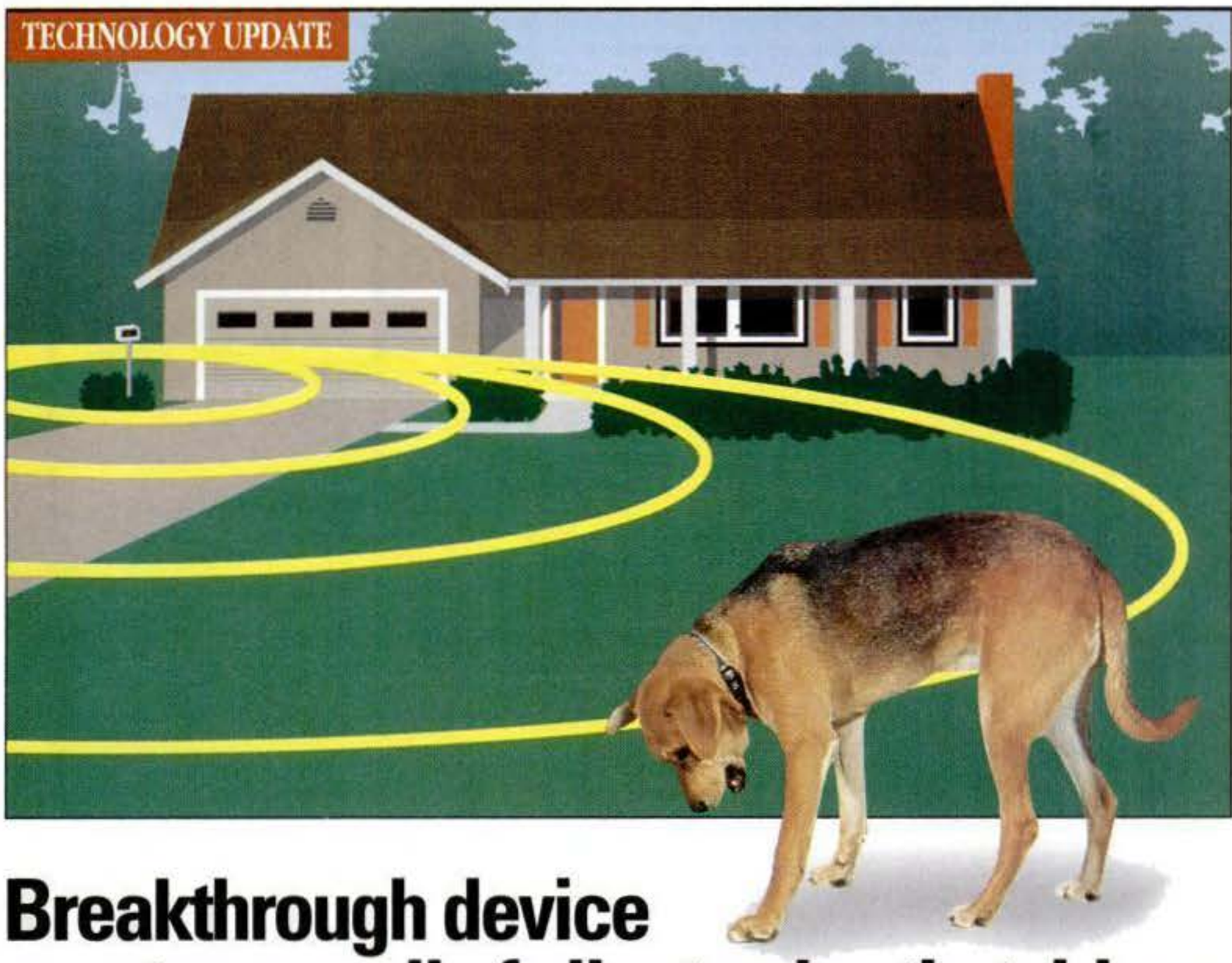
TECHNOLOGY UPDATE



Breakthrough device creates a wall of silent noise that drives away annoying animal pests...

Now you can use ultrasonic power to repel annoying dogs, cats and many wild animals—without harming them.

Be honest. Even if you like animals, you don't want strange animals in your yard. You know what I'm talking about: dogs that dig holes and foul your lawn or cats that trample flowers and sleep on your car.

Common problem. If you live in a rural area, you've probably had trouble with raccoons, skunks or possums. If you live in the southwest, you may even have had problems with armadillos.

Until now, there weren't many options. You wouldn't want to harm a stray animal, and an animal control agency may take days to respond, if they do.

Modern solution. Fortunately, modern technology has provided an answer: the new Yard Gard. It uses high-frequency sound waves to force unwanted animals to leave the area. Yard Gard eliminates the need for repellents, trapping or physical attacks. Pests learn to avoid the areas Yard Gard protects.

Ultrasonic Power. Yard Gard's electronic ultrasonic generator broadcasts powerful "silent noise" that repels four-legged yard pests, yet is generally unobtrusive to people. Tones are harmless but animals find the sounds so unpleasant that they flee.

Why it works. Small animals depend on their acute hearing for survival. They can hear in the 18 to 25.5 kilohertz range which is beyond the range of most humans. When critical hearing frequencies are disrupted by strong pulses, animals feel threatened and leave the noisy area. Yard Gard takes advantage of this fact to protect your yard from pests.

Break their habits. Animals are creatures of habit. They establish a territory and generally follow the same travel routes. Yard Gard forces animals to change their patterns and establish new ones. They soon modify their habitual routes to avoid Yard Gard zones. Once that has happened, they'll no longer be a problem.

Just plug it in. Yard Gard plugs into any standard household outlet. Electricity consumption is very low and costs only about 25¢ a month to operate.

Yard Gard is designed for outdoor operation in all types of weather. You can use your Yard Gard all year round.

Mount your Yard Gard on a wall, post, or fence or place it on a flat surface. Yard Gard is virtually maintenance-free and requires only a minimum of care.

Three settings. Yard Gard has three frequency settings. At its lowest frequency setting, one Yard Gard covers an oval area of approximately 4,000 square feet—the size of an average city lot. Additional units can be added to accommodate especially large yards.

Keep the birds. Do you love to watch and feed birds in your yard? If you have problems with cats chasing birds away or killing them, Yard Gard is the answer. Birds are not affected by high frequency sound waves. They can't hear it, but cats can't stand it.

Try it risk-free. For a limited time, you can get the new Yard Gard at the introductory price of just $99. Call today to take advantage of this special factory-direct pricing. Yard Gard is backed by Comtrad's exclusive risk-free home trial. Try it and if you're not completely satisfied, return it within 30 days for a full "No Questions Asked" refund. Yard Gard is also backed by a two-year manufacturer's warranty. Most orders are processed within 72 hours and shipped UPS.

Are animals turning your yard into a zoo?

Do cats think your garden is a litter box?

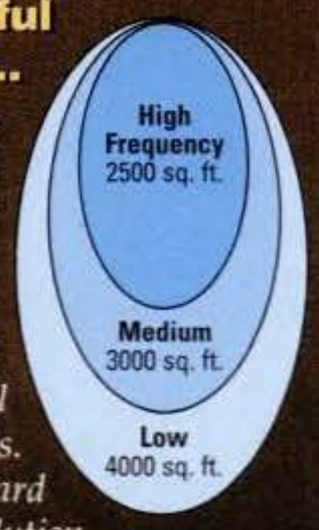
Are rabbits eating as much from your garden as you are?

Do you have problems with unusual animals?

Mount Yard Gard to a fence or porch railing, or place it on a post.

Proven powerful and effective...

In the past, people relied on traps or poisons to get rid of pests. But environmental awareness has increased the demand for clean, non-lethal pest control methods. Safe and humane, Yard Gard is the perfect solution.



Humane. *Yard Gard causes no harm to animals. By creating a wall of high-frequency sound, it forces them to leave the area and create new habitual routes. While the sound is very annoying to animals, it is virtually unobtrusive to people.*

Non-toxic. *Chemicals used to eliminate pests can be dangerous to neighborhood pets or humans. Yard Gard poses no health risk when used properly.*

Nature-friendly. *Poisons and pesticides can pollute soil and water sources. Yard Gard deters pests with sound so it causes no damage to the environment.*

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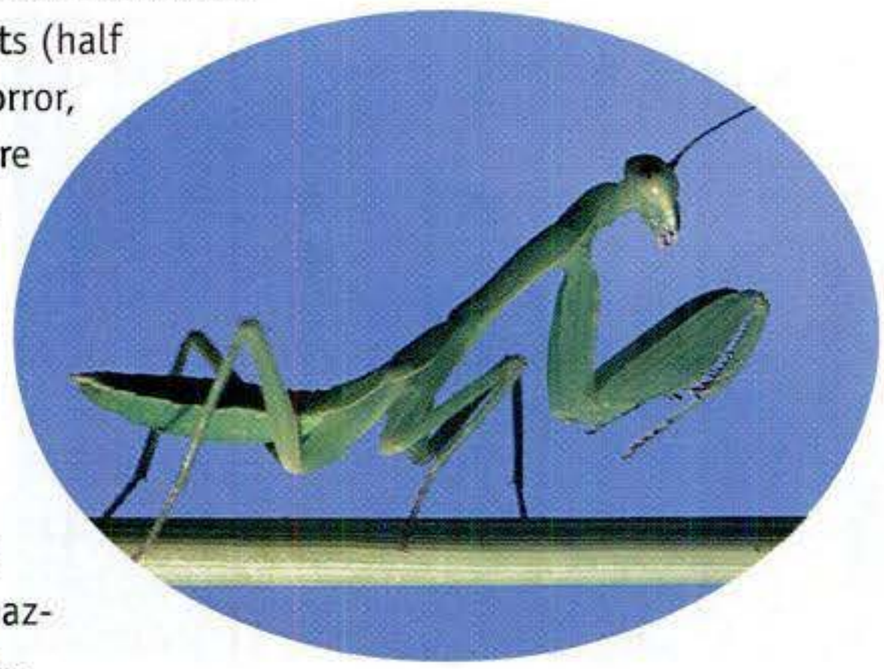
TONY STONE WORLDWIDE

THE FACTS

Hey, What's All the Bugaboo?

WE SHARE THIS PLANET with more than 600,000 species of insects (half of which, often to our horror, are beetles). In fact, there are so many bugs inhabiting the planet that for every pound of human flesh, there are upward of 300 pounds of insects.

Herewith are some of these creatures' more amazing and unusual exploits...
—*compiled by Kal Island*



A mantis holds its forelimbs up as if in prayer.

The density of a typical locust swarm ranges from 100 to 500 million bugs per square mile. The average swarm covers more than 400 square miles—an area that measures several times the size of Washington, D.C.—and can contain up to a total of 50 billion locusts.

While the females of many praying mantis species will try to eat their mates during copulation (and many times succeed), one North American variety of mantis is without any males at all. All offspring are female and are born from unfertilized eggs through a reproductive process known as parthenogenesis.

Dragonflies have been clocked at speeds of up to 60 mph. They move their sets of wings in opposite directions to create more lift for their weight than the most efficient airplanes. The Air Force, Navy, and NASA have studied these insects for their aerodynamic abilities.

The tiny Drosophila fruit fly produces a sperm 2.3 inches long, or about 20 times as long as the fly itself, and 1,000 times longer than the average human sperm.

The semen of the male fruit fly has been found to be toxic to the female. The more partners a female fruit fly has, the shorter her life span. Ironically, the purpose of this toxicity is not to kill the female, but to destroy rival sperm cells from competing males.

Having trouble getting rid of roaches? Maybe it's because they're so smart. Not only are cockroaches one of the few insects that can be taught to run mazes, they can also learn new behaviors *without their heads*. Decapitated roaches subject to electric shocks learn to avoid the shocks after only about 30 minutes of exposure. Headless roaches can live for several days, until they eventually die of starvation.

Forensic entomologists have been using insects for more than 100 years to determine the time of death of murder victims. A unique species of carrion insect will inhabit a corpse at each stage of decomposition, and experts can determine the time of death to within a few hours by noting the species present.

Still, if you rephrase your question to ask which is superior—the eye's ability to perceive details or the screen's ability to produce them—there is a mathematical answer. The key, explains Brian Wandell, professor at Stanford University and author of the book, *Foundations of Vision*, is the distance of your eye from the screen.

Scientists measure what the eye sees in terms of degree of visual angle. A simple way to understand a visual angle is to envision looking through the narrow end of a cone. What you see is received by a particular number of sensors in your eye—whether the wide end of the cone is two inches from your nose or two yards. The top and bottom walls of that imaginary cone represent the visual angle; it can be divided into individual degrees.

For each degree of visual angle, you'll see a certain number of pixels—a few if you're close to the screen, and more if you're farther away. So, Wandell says, the questions should be: "How many sensors are there, per square degree of angle? And how many pixels are there, per square degree of angle?"

For example, Wandell says, let's imagine a screen that is 15 inches wide and 15 inches high. Your eye is 12 inches away. Using trigonometry, one can calculate that the visual angle is approximately 50 degrees wide and 50 degrees high—or, 2,500 square degrees.

Now, he says, suppose the screen has approximately a million pixels. "So you have a million pixels distributed around something that's 2,500 square degrees. That gives you about 400 pixels per square degree."

How many sensors does the retina have per square degree? Near its center it has 14,000.

Thus, your eye has more than 30 times as many sensors as there are pixels in the equivalent area of the screen at that distance.

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What is the best way to measure radon in my house?

Steven K. Kormmenhoek
Skrom@aol.com

RADON, a naturally occurring radioactive gas, can percolate up from soil into houses. Studies have linked radon exposure with increased risk of lung cancer. Radon testing kits sell in stores for $20 to $25. You should look for one labeled as state-certified, or having passed the EPA's testing program.

Short-term tests (ones taking two to 90 days to conduct) are convenient but are considered less reliable than longer-term tests (90-plus days). Both types require that you mail the kit material to a lab for evaluation once the sampling period is over. The EPA recommends that you try a short-term test first; then, if your home's radon levels are high, take a longer-term test to verify the results.

Yet a third option is hiring state-certified or EPA-qualified professional testers. They may use sophisticated equipment that measures other parameters that could affect the radon level (like your home's air pressures, humidity levels, and temperatures over time), but the cost will be considerably higher, from $70 to $300. Testers won't necessarily measure your long-term radon exposure any better than a good kit, but they may help pinpoint the cause.

For more information, call the National Safety Council's radon hot line, 1-800-SOS-RADON. If your home tests higher than 4 picocuries per liter and you are considering remediation, call the Consumer Federation of America Fix-It Line, 1-800-644-6999.

Why can't we load a cargo of nuclear waste and other hazardous materials into a rocket and launch it directly into the sun?

Henry Butler
HButler@aol.com

IT'S TECHNOLOGICALLY feasible but would be far too dangerous. The biggest risk is that the rocket would explode (as rockets have a tendency to do) and send nuclear debris all over the planet. "It's just not something we would entertain," says NASA's John Taylor.

Safety considerations aside, it would also be too expensive. The United States has roughly 30,000

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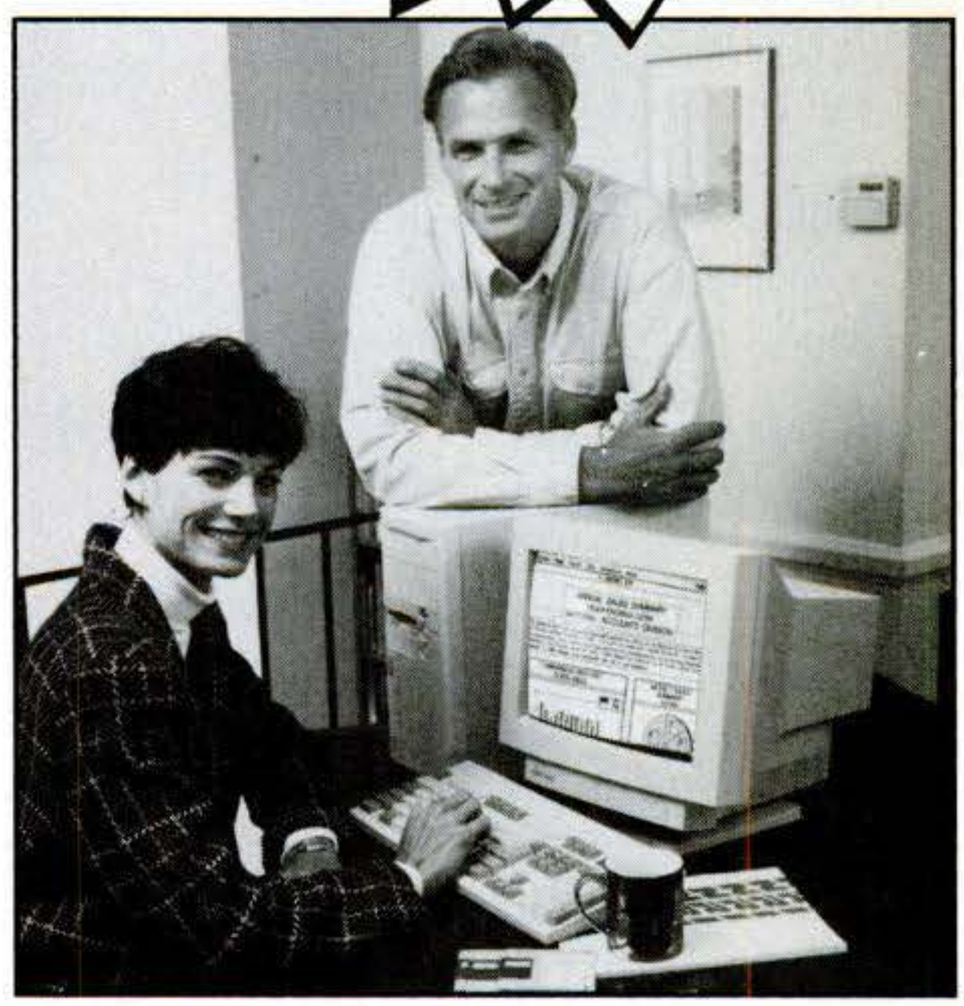

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What makes and keeps the Earth's core so hot?

L. Butler
Butler@ten-nash.ten.k12.tn.us

FIRST OF ALL, Earth's core started out hot. In a recently published book entitled *Naked Earth: The New Geophysics*, author Shawna Vogel explains that Earth's iron core formed early in the planet's history, when Earth was only a fiery mass: "All the iron in the planet turned to liquid and, because of iron's great weight, the tiny droplets sank to the center of the planet. Swirling currents of molten metal collected in a central ball that spanned nearly half of Earth's radius.

"There the iron sits today. At Earth's center, the temperatures reach thousands of degrees Fahrenheit. Yet in spite of this tremendous heat, geophysicists now know that the iron in the core didn't stay completely molten," Vogel writes. The nucleus of the core has been squeezed into solid iron by the intense gravitational pressure of the material around it.

Heat rising from Earth's iron core drives volcanoes, hydrothermal vents, the movement of the continental plates, and other geophysical processes on the planet's surface. "Gradually all of these processes are cooling Earth," Vogel explains. But long before the iron core turns cold, our sun will have evolved into a giant red star so big that it will swallow Earth up completely in its expanding sphere of heat.

When reducing the coefficient of drag from 0.4 to 0.3, what percentage increase can you expect in gas mileage?

Joseph Winering
Willingboro, N.J.

THE DRAG from wind resistance increases with the square of velocity, which means that lowering the coefficient of drag (a measure of the wind resistance of two cars with the same frontal area) becomes more important as speed increases. At 60 mph, about 60 percent of the total drag is wind resistance (the rest of the drag comes from rolling resistance, internal engine drag, and other factors). So a 25 percent improvement in the coefficient of drag should translate into a 15 percent improvement in mileage. At slower speeds, the coefficient of drag becomes almost meaningless.

It's worth noting that drag coefficient is multiplied by frontal area to get an index of total wind resistance. Thus, sleek aerodynamics mean more in a minivan or other full-size car than in, say, a sports car.

How does RAM work?

Dave Drager
Pottstown, Pa.

THINK OF RAM as your computer's short-term memory, and disk storage (on floppy, hard, or CD-ROM drives) as its long-term memory. A computer's random-access memory, or RAM, stores the programs you use and the data you create in a temporary holding area—literally, as electrical pulses that are directed by tiny transistors and stored in even smaller capacitors on the memory chips in your PC. It keeps the information there so programs and data can be accessed quickly (at the speed of electricity) and in random order (hence the name), rather than at the relatively slow rates of magnetic "read" heads roaming over spinning hard disks.

The downside to typical "dynamic" RAM storage is that it requires a constant flow of electricity to keep its capacitors charged and the data alive. When you shut off your PC, your RAM is wiped clean—so if you didn't save that memo to disk, it's gone forever. Some newer types of memory chips, including "flash" (FRAM) and "static" (SRAM) memory, are designed to retain data even after a computer is switched off. But these chips are quite expensive compared to dynamic RAM and are generally used for narrower record-keeping purposes within PCs.

How do carbon monoxide detectors work, and what, if any, are their limitations?

David Yashar
Providence, R.I.

TWO TYPES of technologies are used in carbon monoxide (CO) detectors. The most common is the "Gel Cell," which consists of a biomimetic (mimicking biology) sensor that attracts CO in much the same way that hemoglobin in the blood does. The sensor, normally amber, turns dark in the presence of CO. The other type of detector senses CO with the aid of a microprocessor that measures the electrical resistance of a tin oxide plate, whose resistance changes in the presence of carbon monoxide.

Both types of detectors can be adversely affected by temperature and humidity. Last December, a temperature inversion in Chicago caused unusually high amounts of CO to become trapped at ground level, resulting in thousands of false alarms from CO detectors. First Alert's heavily marketed biomimetic detector came under strong criti-

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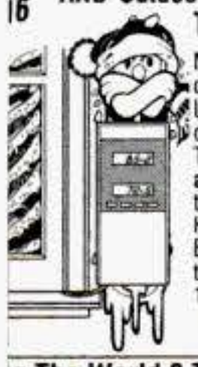

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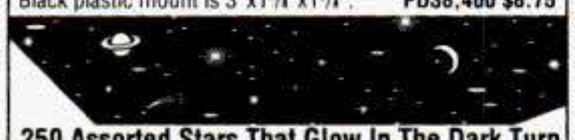

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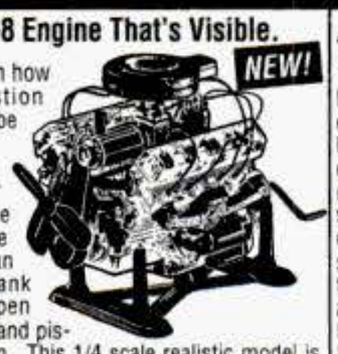

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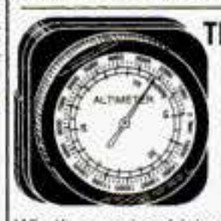

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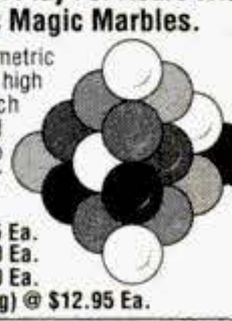

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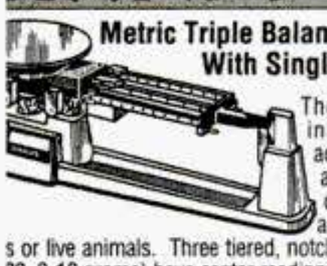

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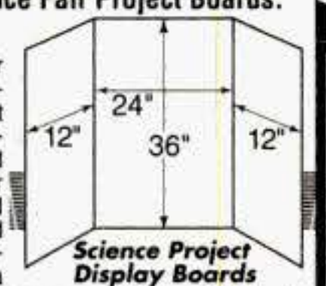

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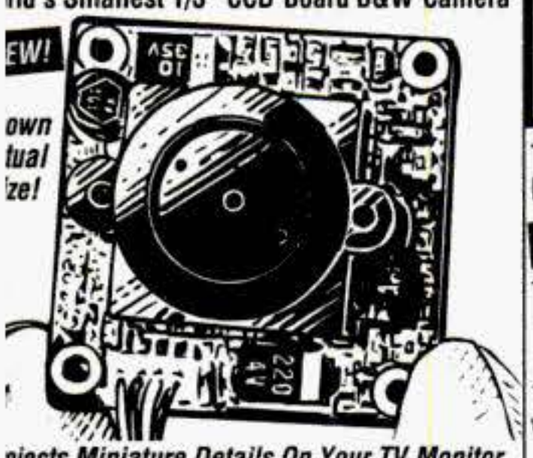

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NEW! Russian Night Vision Scope... Ideal For Law Enforcement, Astronomy, Navigation And Camping.

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cism during that same time period.

First Alert says it has rejiggered its biomimetic detector to comply with new Underwriters Laboratory standards. These standards require all detectors approved by the UL to ignore very low levels of CO for a period of 30 days, rather than for previous eight hours.

Nevertheless, *Consumer Reports* concluded in a recent test that the tin oxide models are superior. You can tell what type of technology a detector uses by whether it is battery operated or not. Plug-in models use metal plates; battery- powered ones are biomimetic.

If my understanding is correct, we don't have a vaccine for the common cold because there are hundreds of different types of cold virus. If that is true, why don't we contract two or more types simultaneously? Or do we?

Jean Simon
Moravian, Neb.

AS YOU correctly state, one reason scientists haven't developed a vaccine that's effective against the common cold is because so many different cold viruses exist. It is possible to be infected by more than one type of virus at a time. When a virus attacks, your body's defense mechanisms go into high gear, but that doesn't always prevent a second infection.

What's the significance of finding the top quark?

Dave Drager
Pottstown, Pa.

THE DISCOVERY of the quark culminated a three-decade chase.

It started in 1963, when Murray Gell-Mann (and, independently, George Zweig) devised a systematic organization of fundamental particles he called quarks, which in various combinations compose the basic stuff of matter. (The word *quark*, by the way, has no particular scientific significance; Gell-Man borrowed it from James Joyce's novel *Finnegan's Wake*.) Eventually, theorists concluded that six different quarks of different masses, quaintly named up, down, strange, charmed, top, and bottom, had to exist. All except the top were found in the short-lived debris of high-energy collisions of particles inside accelerators.

By this time, an overarching "theory of everything" called the Standard Model was in place to explain both the properties of matter and all the forces of nature, with the exception of gravity. But because the top was so massive, it needed extraordinarily violent collisions to be born: In the world of particle physics, mass equals energy. It wasn't until 1977 that atom smashers were powerful enough to even attempt to find it. The epochal birth finally happened at Fermilab's huge Tevatron accelerator in Batavia, Illinois.

If the top quark had not emerged, it would have called into question the whole underpinning of the Standard Model, and modern physics would have had to go back to the drawing board. Or as Gell-Mann once wrote, theoretical physicists would be compelled to fall on their fountain pens.

A box of TSP cleaner I had bought turned lumpy after sitting on the shelf for a while. I thought, no sweat, I'll just microwave the moisture out, and it will run free again. To my surprise, the lumps turned into glass. Why?

W. Leonard Orr
Vancouver, Canada

MICROWAVES heat food by exciting the water molecules present. TSP (tri-sodium phosphate) is a hydrate, meaning that water molecules are attached to the phosphate crystals. According to Jenifer Taylor, a ceramics engineer at Alfred University, TSP melts at only 167°F—lower than the boiling point of water—so the lumps in your TSP melted before the water boiled away. TSP is a salt, and as with all salts, if melted and cooled rapidly, it turns into a glassy material. Had you cooled it more slowly, the material probably would have re-crystallized. "Drying the lumpy TSP for laundry use might better be done in a warm oven—below 167°F," suggests Taylor.

I read somewhere that today's personal computers are more powerful than those used on Apollo 11. Is this true?

Wiratorn Ruksvanichpongs
s6014498@crsc.kmitl.ac.th

COMPARED WITH what was available to the Apollo astronauts, the computer power that PC users have at their fingertips today is almost scary. The Apollo 11 Guidance Computer had 2K of RAM and 36K of ROM, and barreled along at 1MHz. The circuits consisted of 24 modules contained in two trays, weighed 70 pounds, and required 70 watts of power. To issue commands, the astronauts used a unique interface that consisted of a number pad and an LED readout. Commands were issued in a "noun-verb" format; the astronauts would key in numbers that were codes for commands like "display velocity," or "change program."

NASA computers on the ground were somewhat more powerful, but not much, according to Merritt Jones, a space physicist for the Gemini and Apollo programs who now works for IBM. "The machine we used in the Mission Control Center, which was the most powerful commercial machine at the time, could execute one million instructions per second," he recalls. "It cost $4 million and took up most of a room. It

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had one megabyte of memory."

Today, you can buy a PC with 90 times the processing power and 10 times the memory for a few thousand dollars. An average laptop computer not only comes with a full keyboard and mouse, but can run at 75MHz, includes 8 or more megabytes of RAM and 540 megabytes of hard disk space, can execute 90 million instructions per second, and is small and light enough to carry around all day. Talk about a brave new world.

Why the drone tone in a bagpipe?

Hugh Lineback
Siloam Springs, Ark.

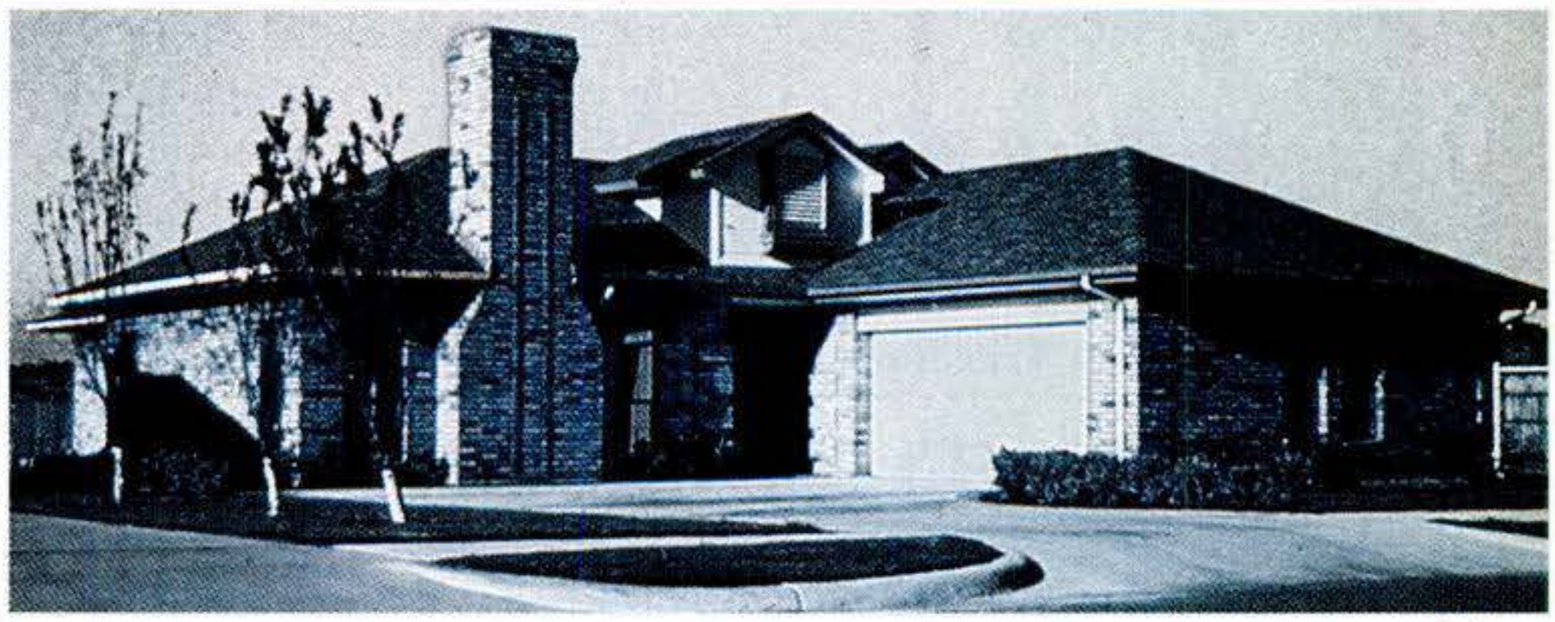
NO COMPLICATED physics here. It's just tradition, according to Andrew McDicken, pipe major of the Clan Gordon Pipe Band on Long Island. While parlor pipes—pipes without the loud droning tones—are, in fact, produced, they do not carry with them the centuries of history associated with the bagpipe, he explains. In bagpipes like the Great War Pipes of Scotland, three drones—a bass and two tenors—rest on the piper's shoulder. In 1745, pipe playing and kilt wearing were banned by the English after their invasion of Scotland. In recent times, both have become powerful national symbols.

I read about the discovery of three planets orbiting a sun about 1,500 light-years distant. Does that mean all suns closer than that are completely devoid of planets?

Dominic S. Burgio
Amherst, N.Y.

THE FACT that extrasolar worlds have so far only been discovered around a star 1,500 light-years off doesn't rule out the existence of planets closer to us.

Distant planets are hard for telescopes to see because they don't shine like stars. Those three new planets orbit an unusual type of ancient stellar remnant called a pulsar, says Pennsylvania State University astronomer Alexander Wolszczan, who discovered the new planets with Dale Frail of the National Radio Astronomy Observatory. Pulsars—remnants of exploded stars—emit precisely timed radio-wave bursts many times per second. Longer than visible light, radio waves travel great distances with less



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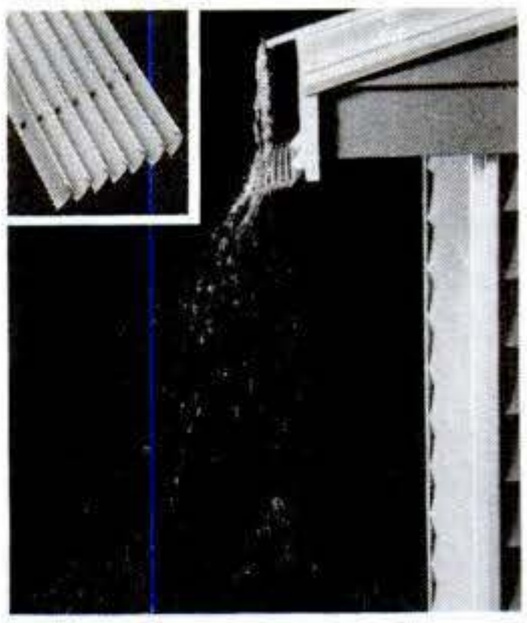

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disruption—so a radio astronomer can have a clearer view of planets than astronomers who work in shorter wavelengths of light, like visible or ultraviolet.

While trying to figure out why a certain pulsar's radio "clock ticks" were slightly off, Wolszczan and Frail found the planets. It turned out that the gravitational field from the three planets was enough to make the pulsar wobble. This altered the star's pulses.

Closer pulsars definitely exist, but no one yet knows whether they are orbited by planets. Wolszcan, however, believes planets may be common. "If you can find planets around a pulsar, you can probably find them anywhere," he declares. Others aren't so certain. Andrea Ghez at the University of California in Los Angeles, for example, reports that 75 percent of our stellar neighbors are binary systems with companion stars too close to allow planetary formation. She argues that the strong gravitational pull of the companions would have sucked any planet-building materials that might have been around billions of years ago into the twin suns.

Why was the name of the huge dinosaur *Brontosaurus* changed to *Apatosaurus*?

acroll@island.net

IN 1877, the Yale paleontologist O.C. Marsh named a fragmentary sauropod dinosaur specimen found in Wyoming *Apatosaurus ajax*. Two years later, he named another partially preserved specimen *Brontosaurus excelsius*. Several years after that, experts concluded that the two differently named specimens were actually one and the same. Because the name *Apatosaurus* appeared earlier in the scientific literature, it is the correct one. Scientifically speaking, there is no such thing as a *Brontosaurus*.

How does an electric eel produce electricity?

Everett Chesley
North Reading, Mass.

ELECTRIC EEL cells, like cells in all other animals, produce tiny electric charges in their normal cell functions. Unlike other creatures, however, electric eels can harness those charges and use them in a variety of ways. For example, they can create an electric field for hunting other fish or defending themselves; navigate cloudy portions of South American rivers (their home turf); and communicate with other electric eels.

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Electric eels are usually gray-brown in color, can grow to nine feet in length, and weigh as much as 50 pounds. The tail section is four-fifths of the eel's total length.

Other electric fish include the electric catfish, found in Africa; the electric stargazer (so called because its eyes are on top of its head), found in the tropical portions of the Atlantic and Pacific Oceans; and the electric ray, found in most warm waters of the world. ◆

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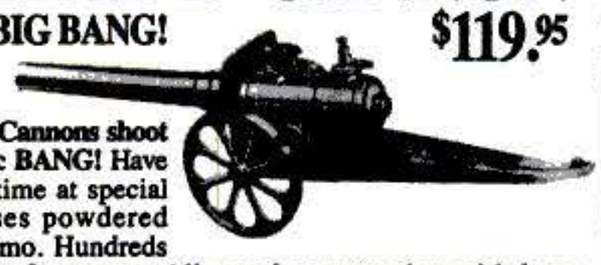

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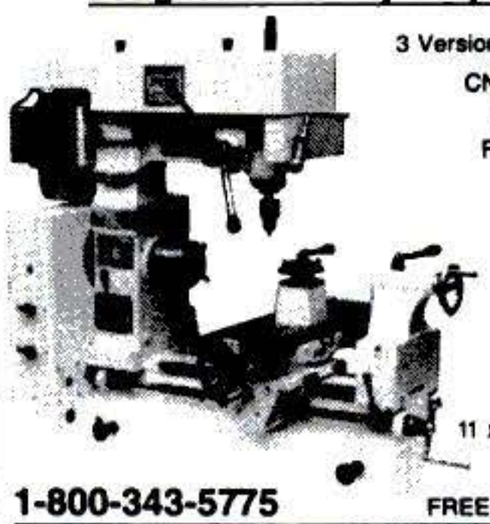

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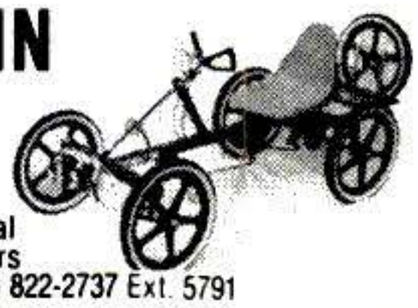

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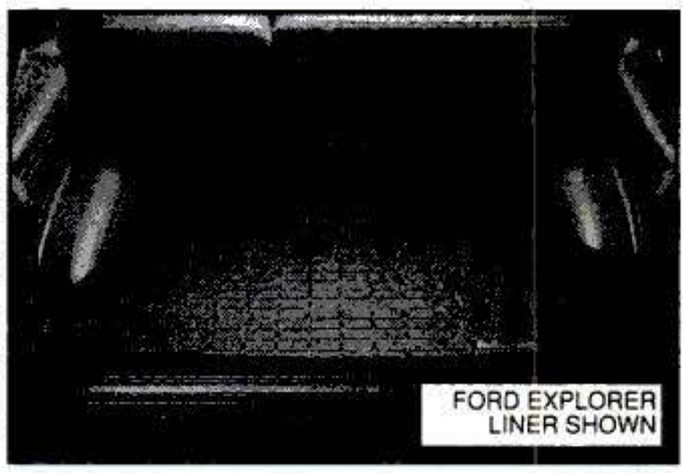

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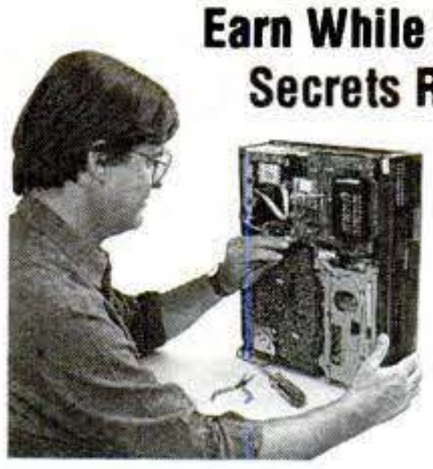

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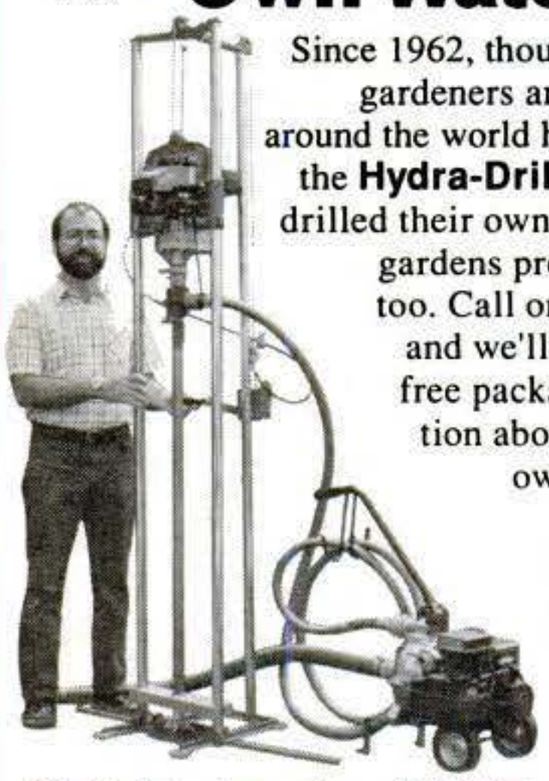

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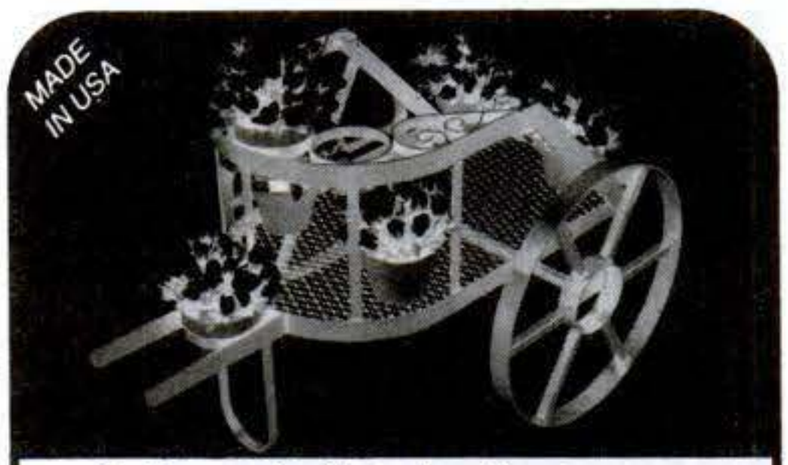

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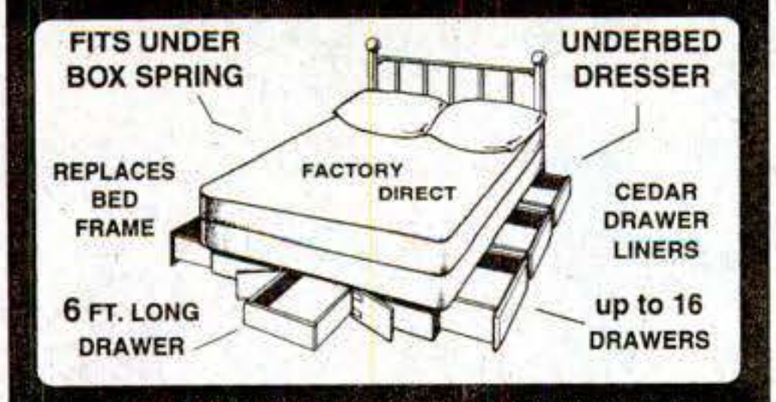

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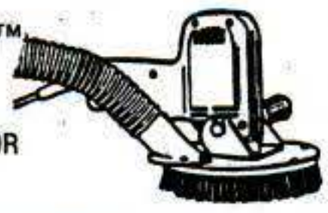

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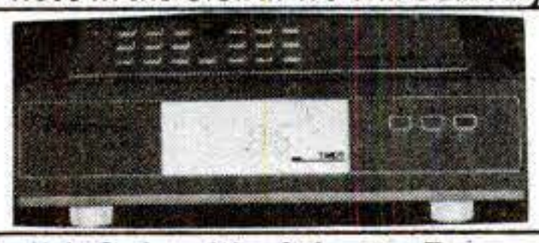

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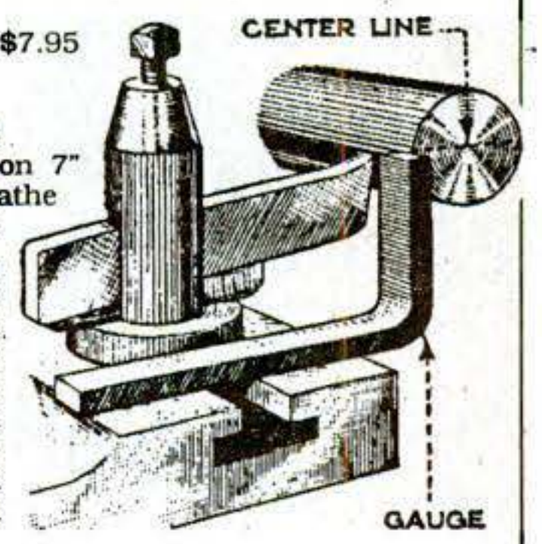

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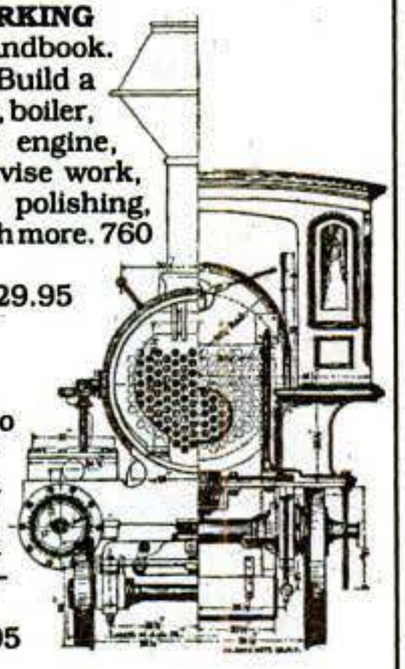

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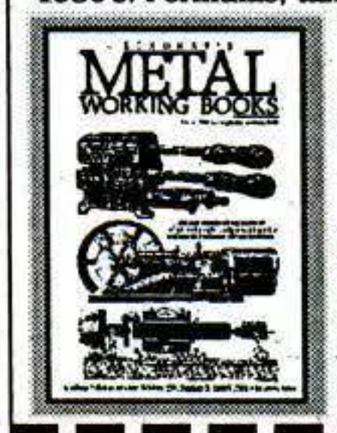

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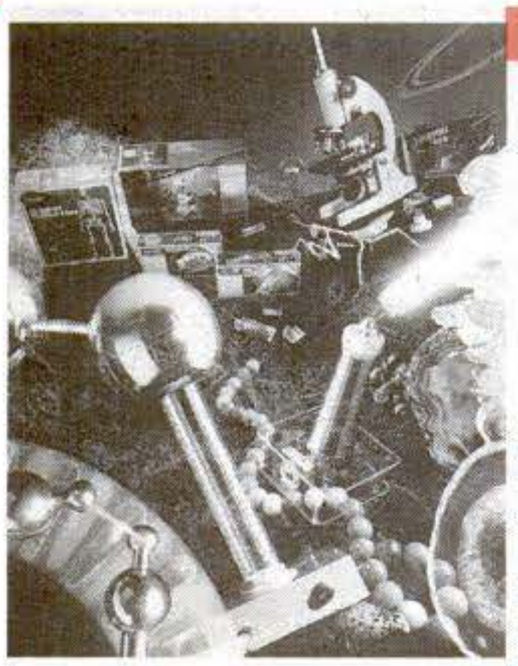

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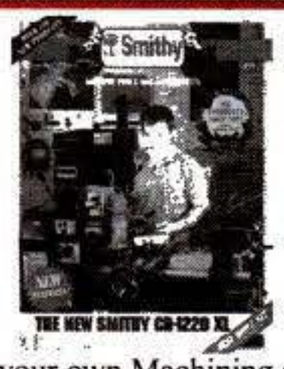

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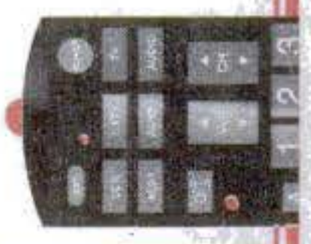

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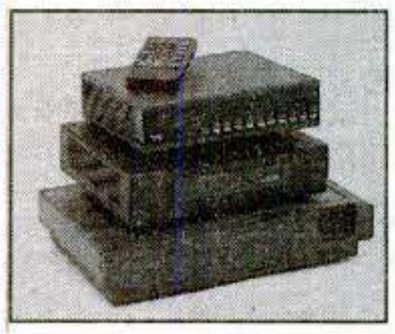

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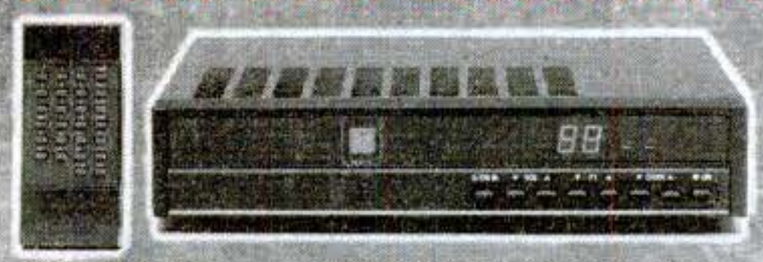

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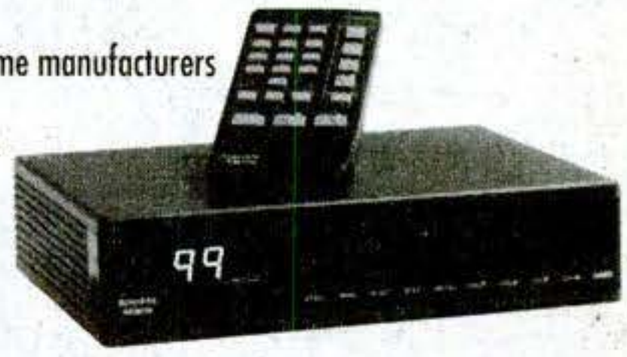

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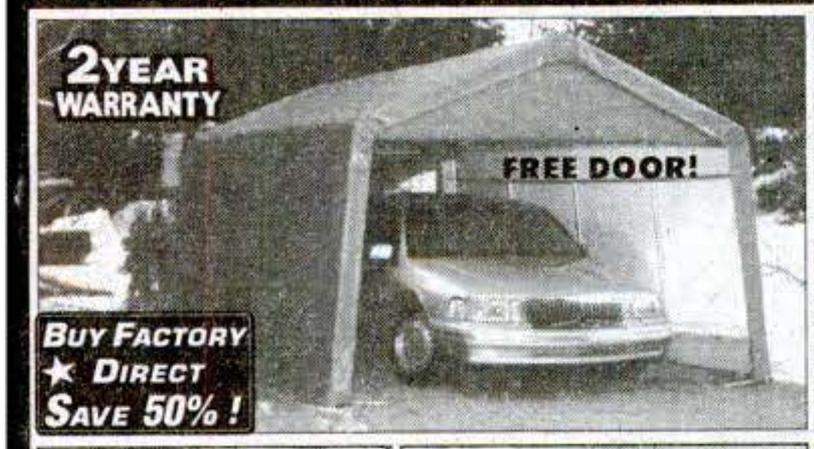

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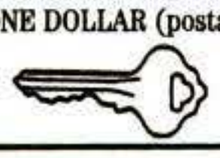

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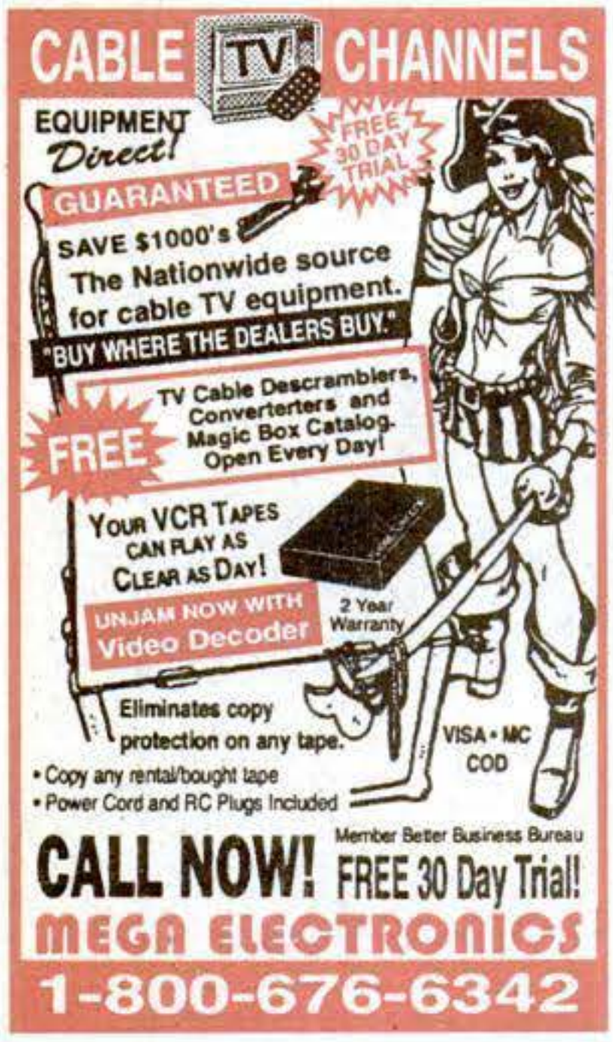

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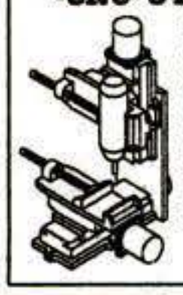

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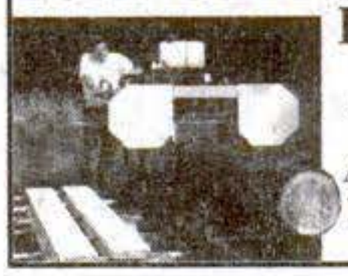

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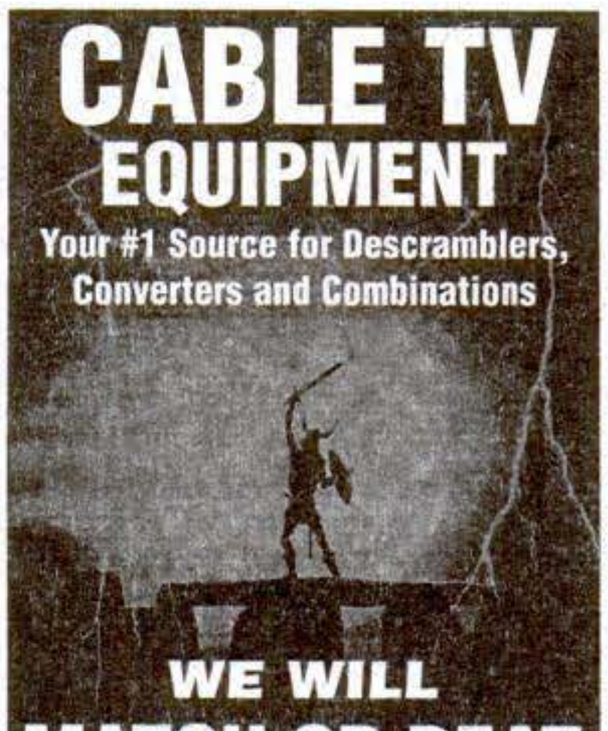

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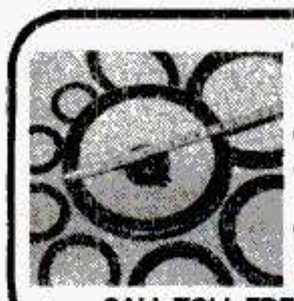

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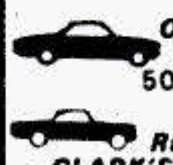

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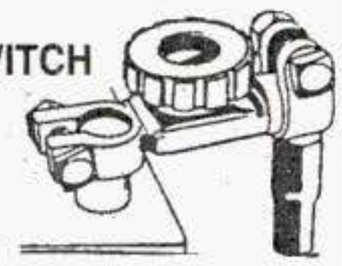

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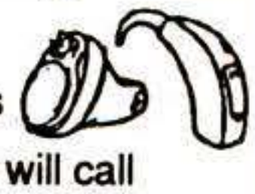

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SAMPLING A CENTURY OF *POPULAR SCIENCE*

Treating Tuberculosis

100 YEARS AGO "THE HISTORY of the treatment of consumption shows that life in the pure air, judicious exercise, sunlight, a nourishing diet, and such aids as cod-liver oil and tonics have effected more than all the bacillicide treatment put together. These all act on the old principle of helping Nature to help herself."—*November 1895*

Today tuberculosis is treated with antibiotics.

Better Television Arrives

50 YEARS AGO "IN THE NEXT SIX MONTHS, and maybe even sooner, you will be able to walk into a television store and say to the man behind the counter, 'I like that one. Wrap it up please.' If you want to pay for it, you can get a screen far larger than any that were produced experimentally before the war. Television is improved because, finally, it is coming of age. The war has done much to improve it. 'In the near future,' predicts Dr. Peter C. Goldmark of CBS, 'we will have pictures that are made up of approximately 1,000 lines, instead of the prewar 525 lines.'"—*November 1945*

Television still uses the 525-line standard. High-definition TV, slated for introduction at the end of the decade, promises pictures of approximately 1,000 lines.

Solar House

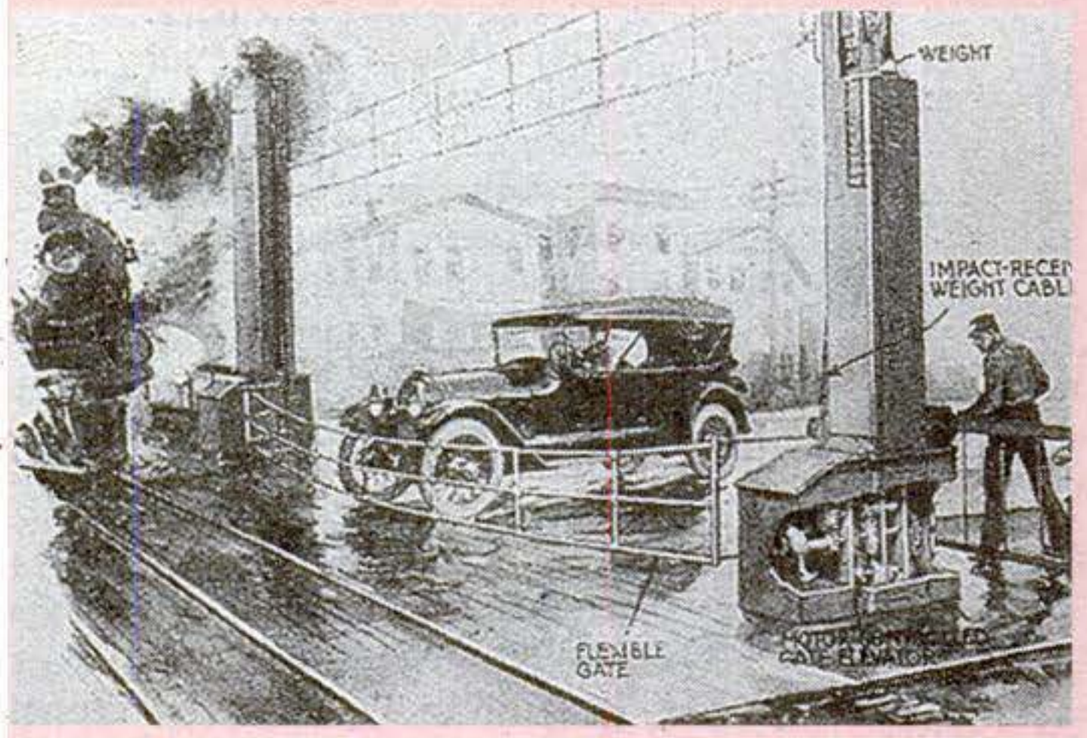
50 YEARS AGO "EVEN IN THE coldest weather, artificial heat is needed only in the morning and evening in this solar house. Heat from the winter sun is drawn into the house by a large south window that consists

of double panes which enclose layers of dehydrated air. During the summer, wide eaves cut off the rays of the high-riding sun."—*November 1945*

Space Workhorse

25 YEARS AGO "LOCKHEED Missile and Space Co. is working on an orbit-to-orbit shuttle for the space age in the 1980s. The spacecraft, also called the space tug, is intended to be used as a repair vehicle. It is slated for such missions as repairing orbiting satellites and rendezvousing with the proposed space shuttle in order to transfer its payloads to higher, hard-to-reach orbits and trajectories."—*November 1970*

Due to insufficient government funding, the space tug was never built.



Stop, Look, and Listen

75 YEARS AGO "A BARRIER TO BLOCK vehicles from crossing the tracks of an oncoming train has been created by an inventor from Chicago. The device consists of two columns on either side of the road which support a flexible gate suspended by weights. The blockade "gives" to prevent the approaching vehicle from being damaged. The gate, operated by motors, lowers as a train approaches."—*November 1920*

The latest railroad crossing innovation is a laminated composite batter-board block that rises from the ground in 20 seconds when activated by an approaching train. It is able to withstand the impact of a 40,000-pound vehicle.

Paved with Molasses

100 YEARS AGO "A SATISFACTORY pavement has been made with leftover molasses obtained from a sugar factory in Chino, California. The molasses is blended with sand to about the consistency of asphalt. The mixture is then laid out exactly like pavement. The composition dries quickly and becomes even harder with the sun's heat."—*November 1895*

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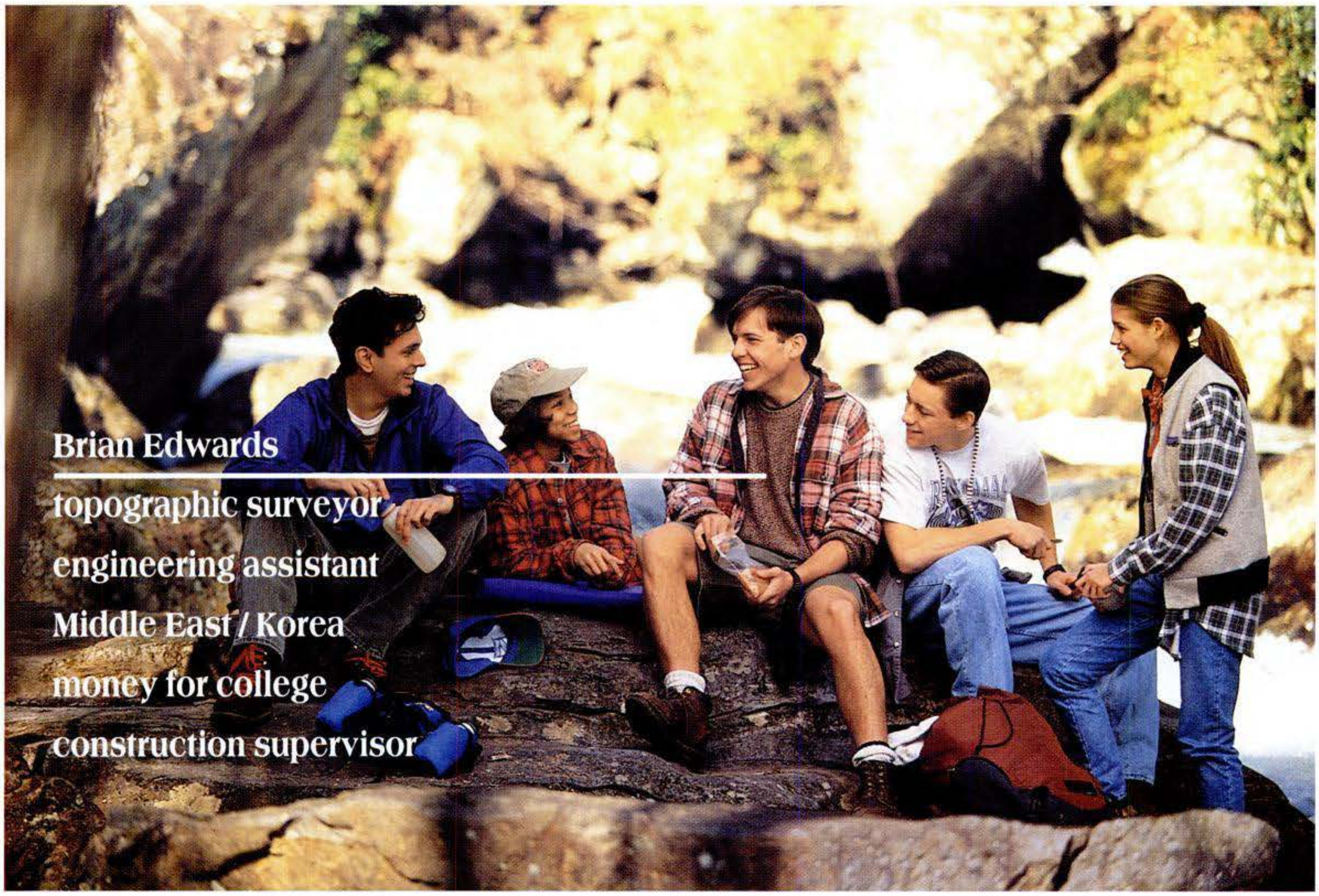

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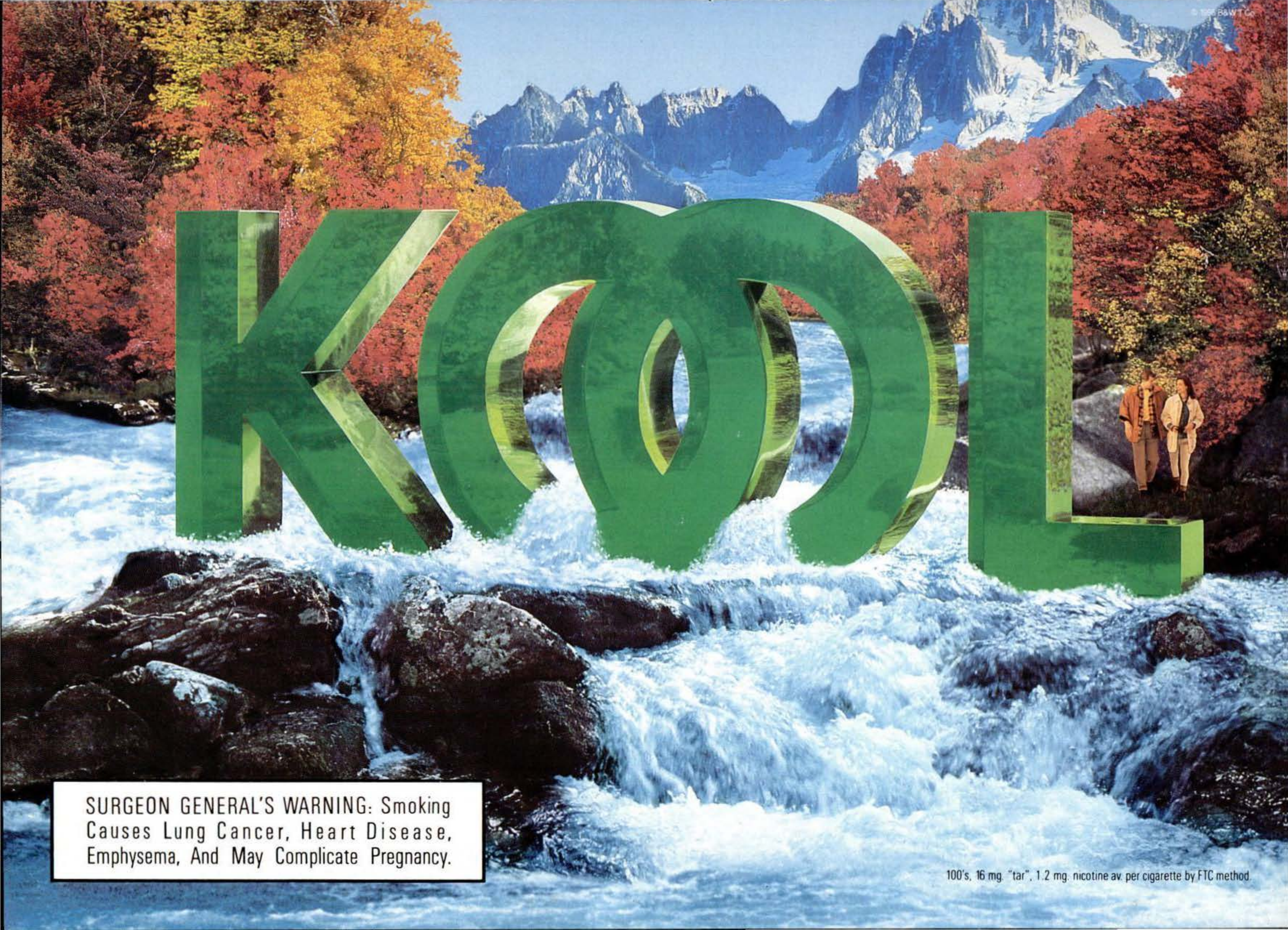
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